THE MAGAZINE OF ENGINEERED CONSTRUCTION

CIVIL ENGINEERING

MAY 1959

JET AIRPORT CONSTRUCTION

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

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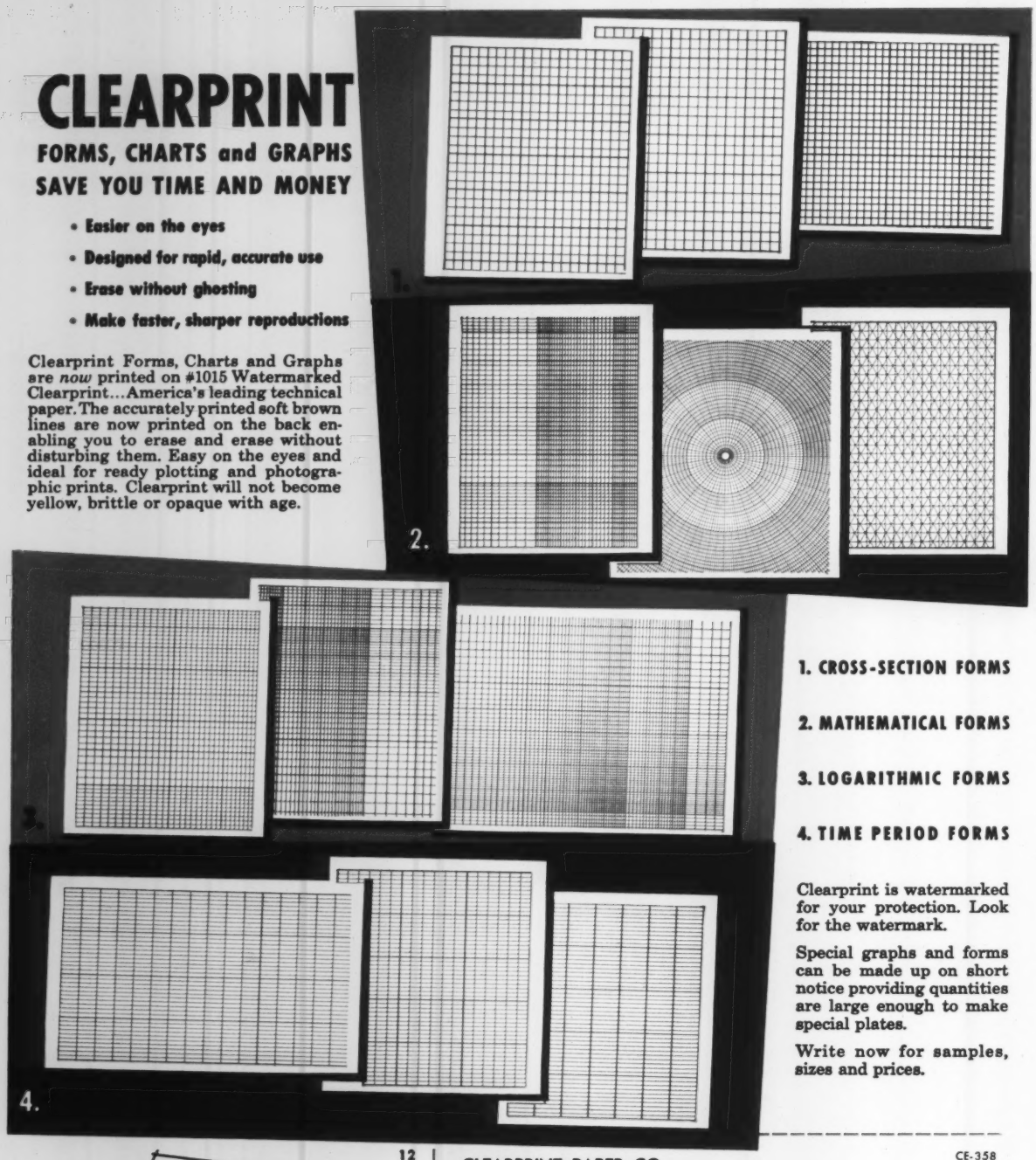

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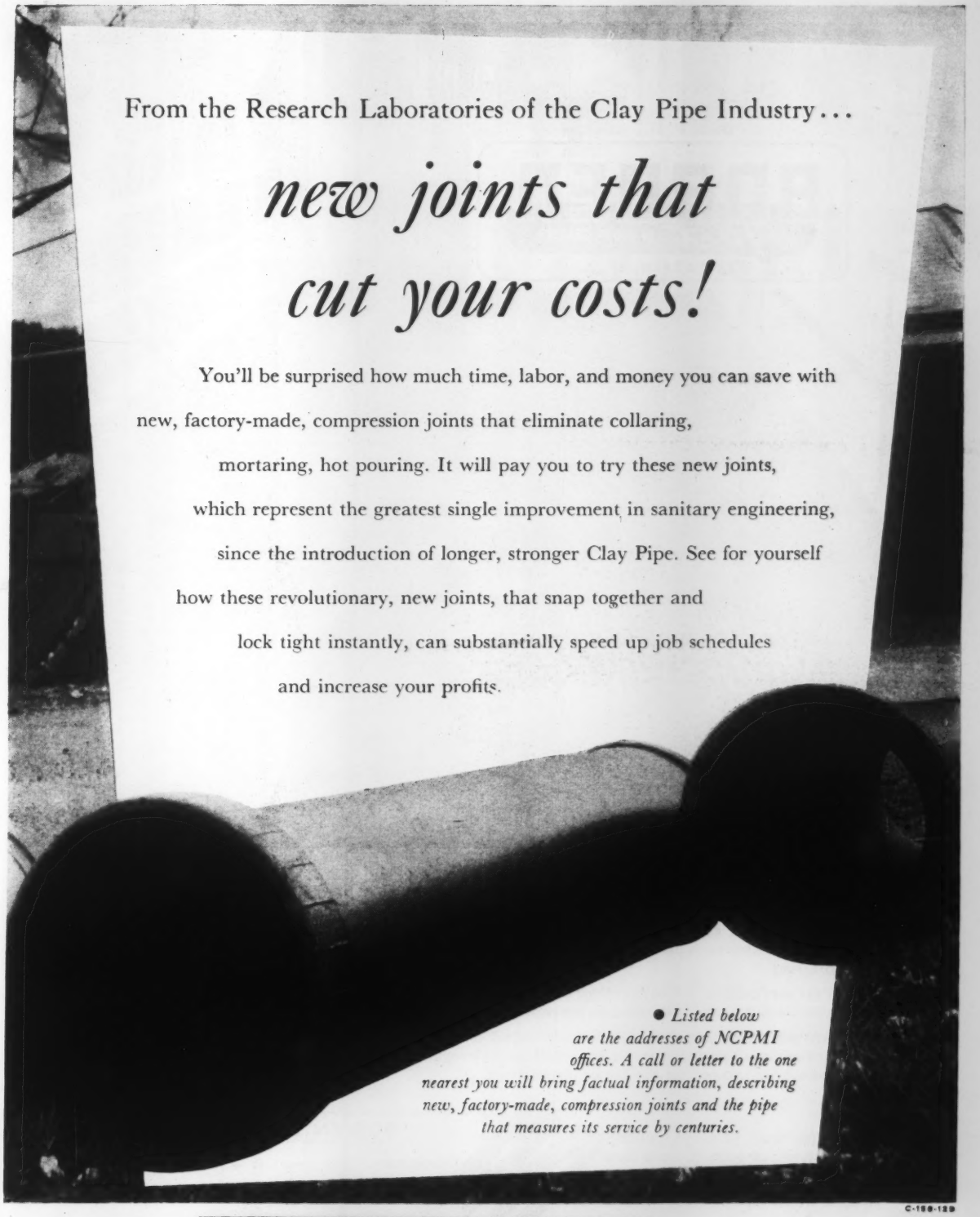

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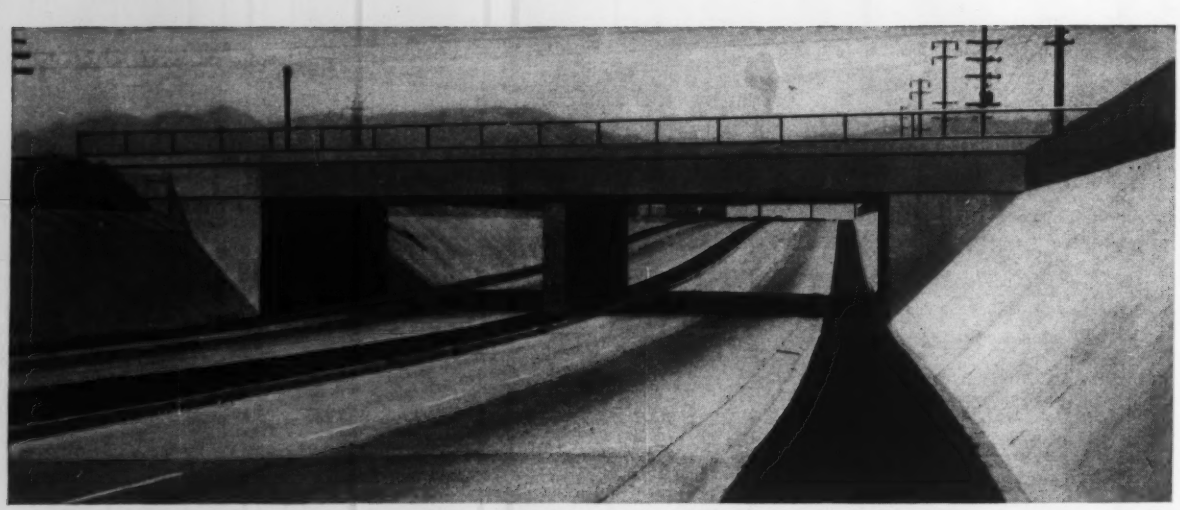

Reinforced CONCRETE

Cored-slab, cast-in-place bridge deck SAVES MATERIALS AND MONEY...

An interesting example of economical and practical bridge design is the new reinforced concrete bridge carrying five tracks of the Santa Fe Railroad over Paramount Boulevard in Los Angeles. The bridge is a two-span, cored-slab, rigid frame structure of reinforced concrete on pile foundations.

Los Angeles Highway Engineers have used this method of construction for many bridge structures. It has proved to be more economical not only because of the ready availability of materials but also because the cored slabs in the reinforced concrete bridge deck reduce dead weight in the completed structure.

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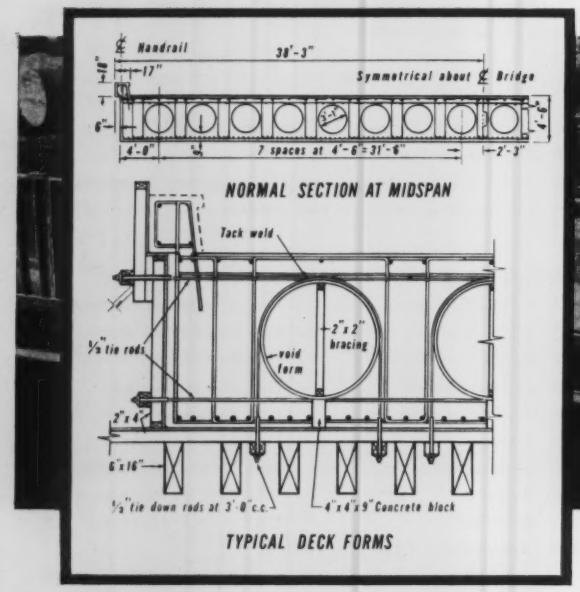

Construction detail of bridge deck forms, reinforcing bars, and void tie-downs.

Santa Fe Railroad Bridge over Paramount Boulevard, Los Angeles, California.
Designer: County of Los Angeles Road Department, Bridge Division.
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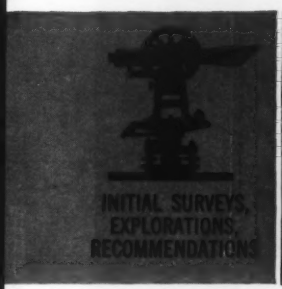

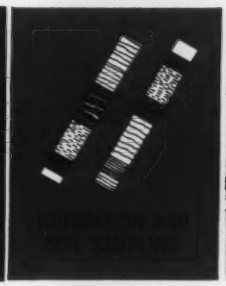

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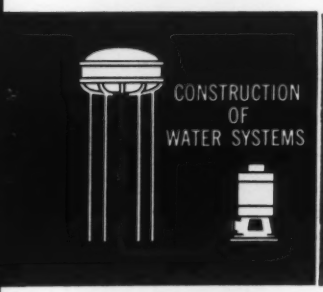

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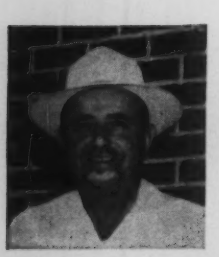

"We improved our masonry mortars by switching to Atlas Masonry Cement"

Project: Barwise Junior High School, Wichita Falls, Texas. **Architects:** Jesse G. Dixon, Arch., R. B. Pardue, Asso., Wichita Falls, Texas. **General Contractor:** W. C. Shelton, Lawton, Okla. **Masonry Contractor:** W. P. Howle, Wichita Falls, Texas. **Dealer:** Stephens Lumber Co., Wichita Falls, Texas.

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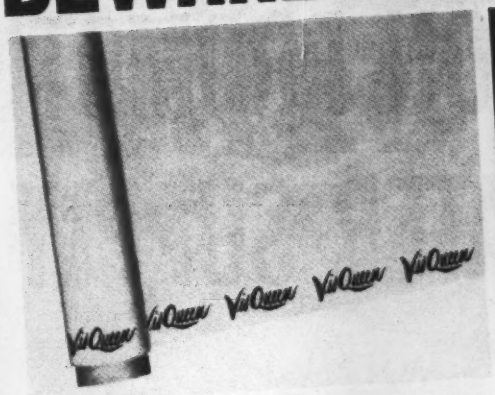

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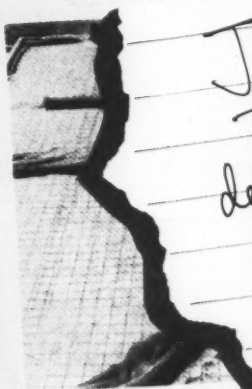

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Similar advertising appears regularly in *U. S. News & World Report, Nation's Business, Better Homes and Gardens, American Home* and *Sunset* magazines.

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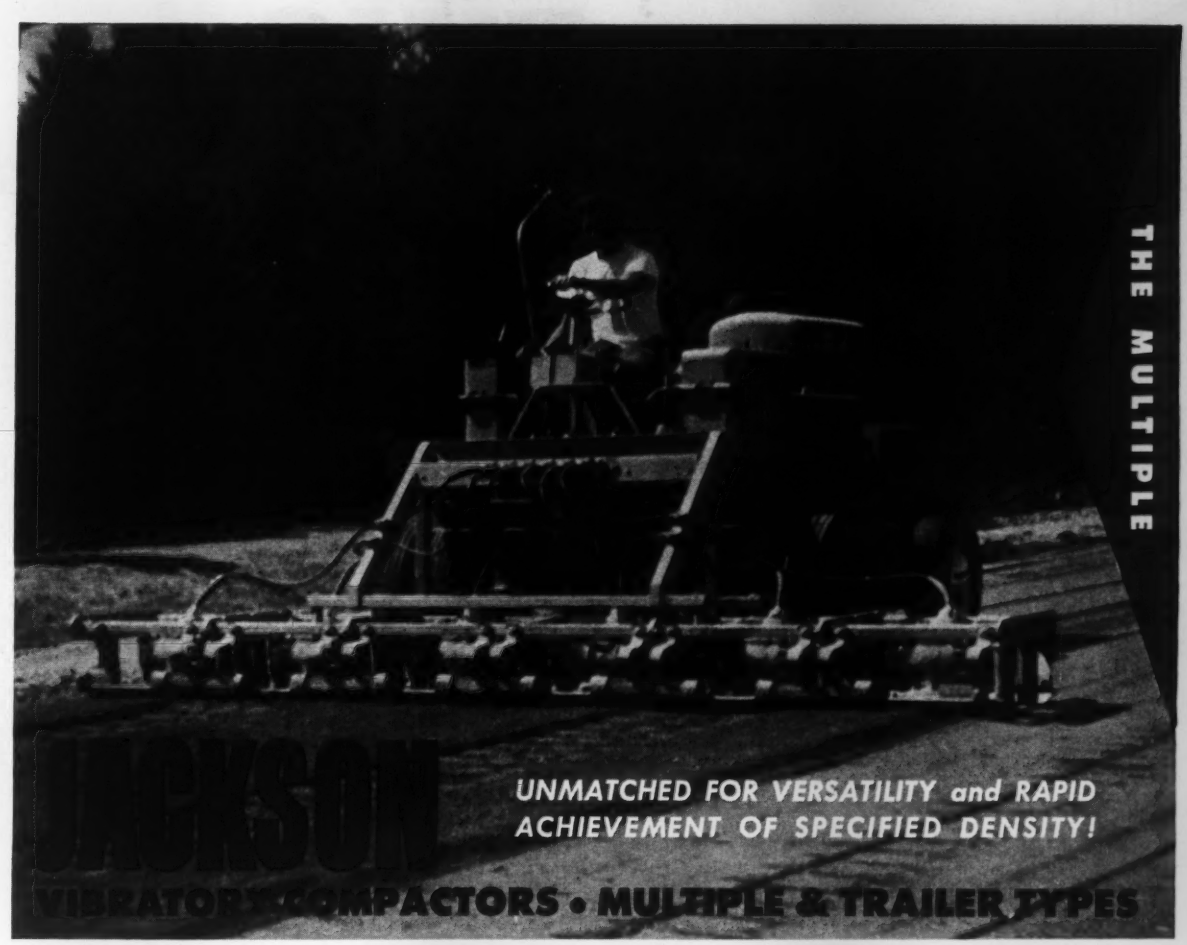
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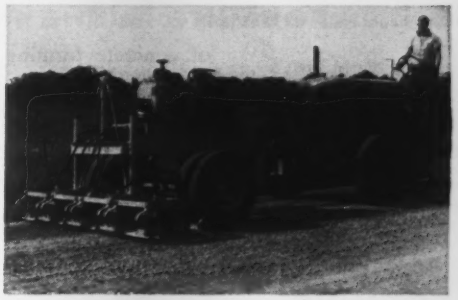

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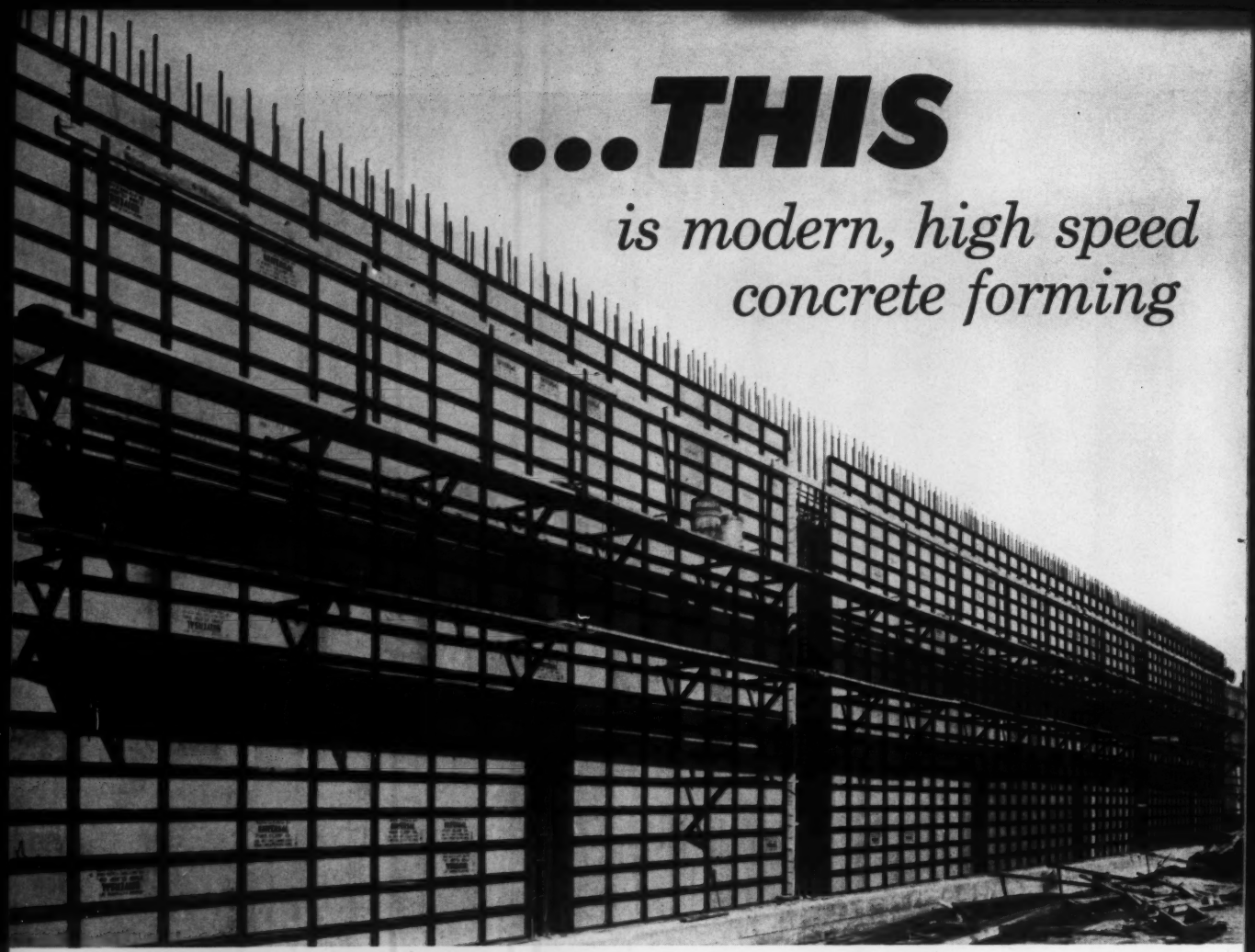

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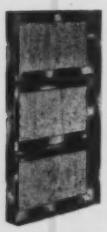

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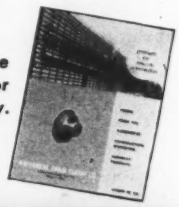

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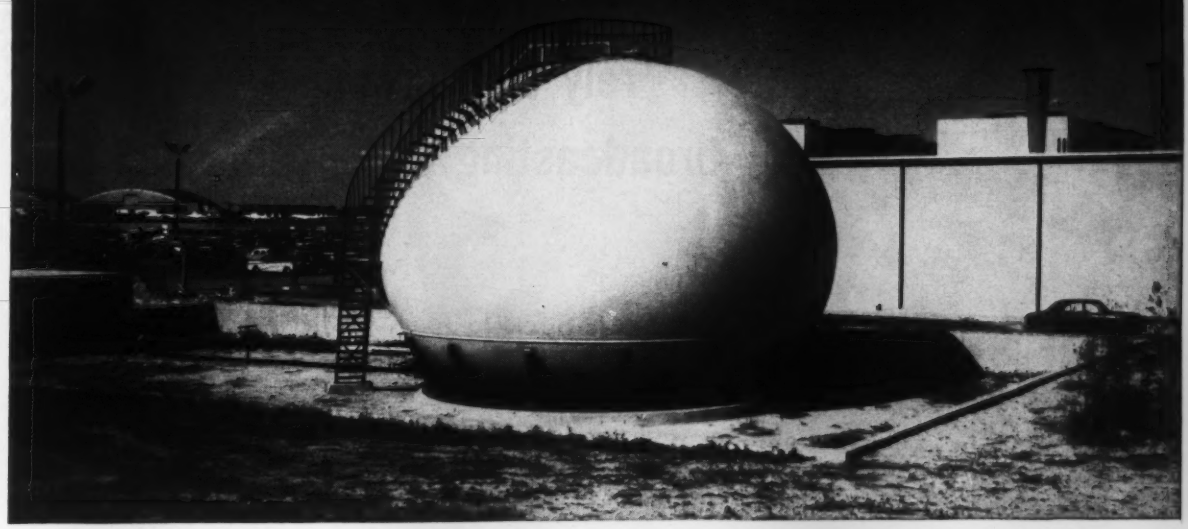

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MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

M3

I want a new plant building.

I want it fast.

I want it strong and tough.

I want few columns, more open areas.

I want a building that's easy to expand.

I want to keep the initial cost low.

I want to keep maintenance costs low, too.

Now, what structural material do you recommend?

Give the man what he wants: Recommend framing his plant building with structural steel. Only steel framing meets all his demands. Both steel producers and steel fabricators have expanded facilities. There's an ample supply of the fabricated structural shapes you need--when you need them.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

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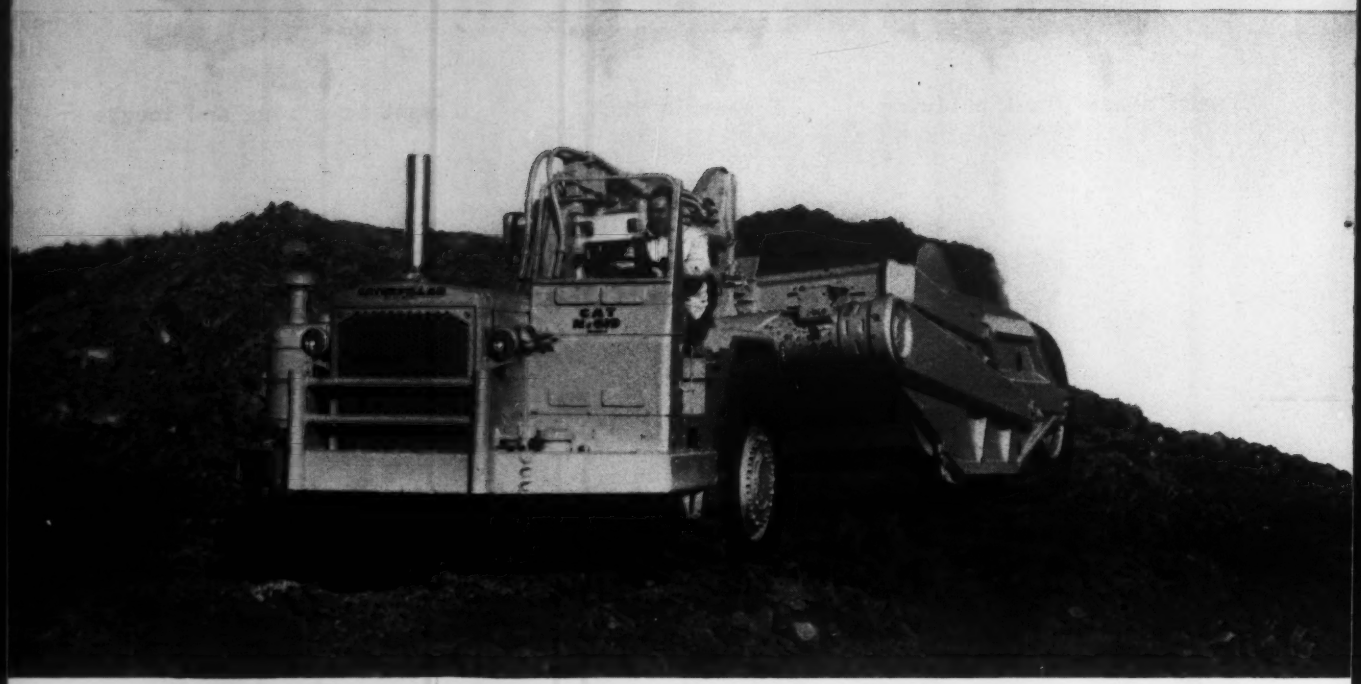
PROJECT PAYDIRT* *pays off again*

NEW 225 HP CAT NO. 619 TWO-WHEEL TRACTOR



- **First two-wheel tractor to deliver four-wheel speed and roadability!**
- **Matched with new No. 442 Series B LOWBOWL Scraper for new high production with 14 cu. yd. struck capacity!**

This new No. 619 Series B represents a major breakthrough in two-wheel tractor-scraper design. It is the first and only broad application two-wheel machine that combines two-wheel traction with four-wheel speed and roadability. It also affords new unit construction and timesaving accessibility never before built into this type of rig.

The No. 619's new turbocharged engine delivers 225 HP and a torque rise of 20% — for fast acceleration. With a top speed of 30.2 MPH, the No. 619 can really run—and run under conditions that slow down other make two-wheel rigs.

That's because of its roadability. Advanced Caterpillar design has achieved a tractor-scraper balance resulting in rides that "smooth out" to an amazing degree. This balance permits higher speeds for more cycles per day and less operator fatigue.

With all this, new hydraulic steering makes the No. 619 extremely easy to maneuver, yet retains that important "feel of the road" touch. Design permits full 90° turns with a turning diameter of 30 feet.

As for unit construction and accessibility, here's one example: A new swing-away dash allows ready access to the starting engine, air compressor and hydraulic pump. Another example: By removing six capscrews in the planet carrier cover, each axle can be removed from the tractor. The planetaries are interchangeable between sides.

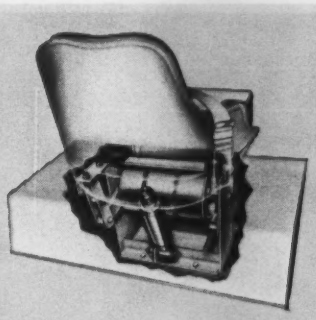
Like all achievements of Caterpillar's Project Paydirt, the No. 619-No. 442 unit has been thoroughly tested. Four years of on-the-job operation prove this: This new "all-job" machine will set new performance records on a broad range of applications.

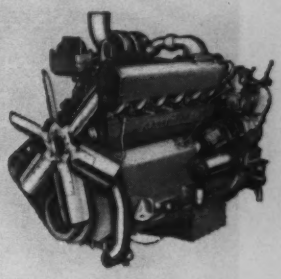
How much does this mean to you profit-wise? Of course, that depends on your jobs. But this is certain—there's nothing like the new No. 619-No. 442 in the field today. Get the complete facts about it from your Caterpillar Dealer, who backs you with round-the-clock service and parts you can trust. Ask for a demonstration. See for yourself how it can step up production and profits on a wide range of applications.

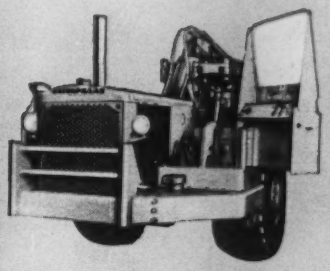
Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

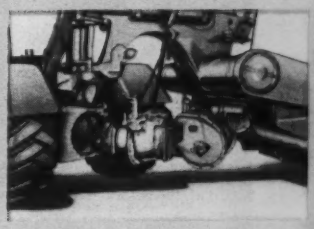
NEW TORSIONFLEX SEAT. New seat provides "highway" ride on off-highway conditions. Helps conserve operator's energy, lessens his fatigue, enables him to do more work per shift. One of many Caterpillar developments.

NEW TURBOCHARGED CAT ENGINE. Designed to meet the specific requirements of the No. 619. Develops 225 HP and a full 20% torque rise—for fast acceleration from cut. Fuel system permits use of economy-type fuels.









NEW NO. 442 SERIES B LOWBOWL SCRAPER. Matched to the No. 619 for high production. Capacities: 14 cu. yd. struck and 18 cu. yd. heaped. Exclusive Caterpillar LOWBOWL design provides a faster loading rate with less resistance throughout the loading cycle. Also available for use with the No. 619 is the 25-ton-capacity Athey PR619 Rear Dump Trailer.

NEW SWING-AWAY DASH. Permits timesaving access to the starting engine, air compressor and hydraulic pump. Entire left side of engine can be exposed without having to disassemble any major components connected with dash.

NEW UNIT CONSTRUCTION. Offers unmatched accessibility for servicing. Transmission differential and cable control can be quickly removed as unit. Each axle can be pulled out by removing six capscrews from planet carrier cover.

Additional facts about the No. 619-No. 442—Six-speed forward, two-speed reverse constant mesh transmission • Standard wide-base 26.5-25, 24-ply tires all around—optional tread and ply ratings available • Choice of in-seat gasoline starting or direct electric starting • New dry-type air cleaner • Fuel tank capacity—85 U. S. gallons • Shipping width—10 feet, 10 inches.

CATERPILLAR'S *PROJECT PAYDIRT*

***PROJECT PAYDIRT:**

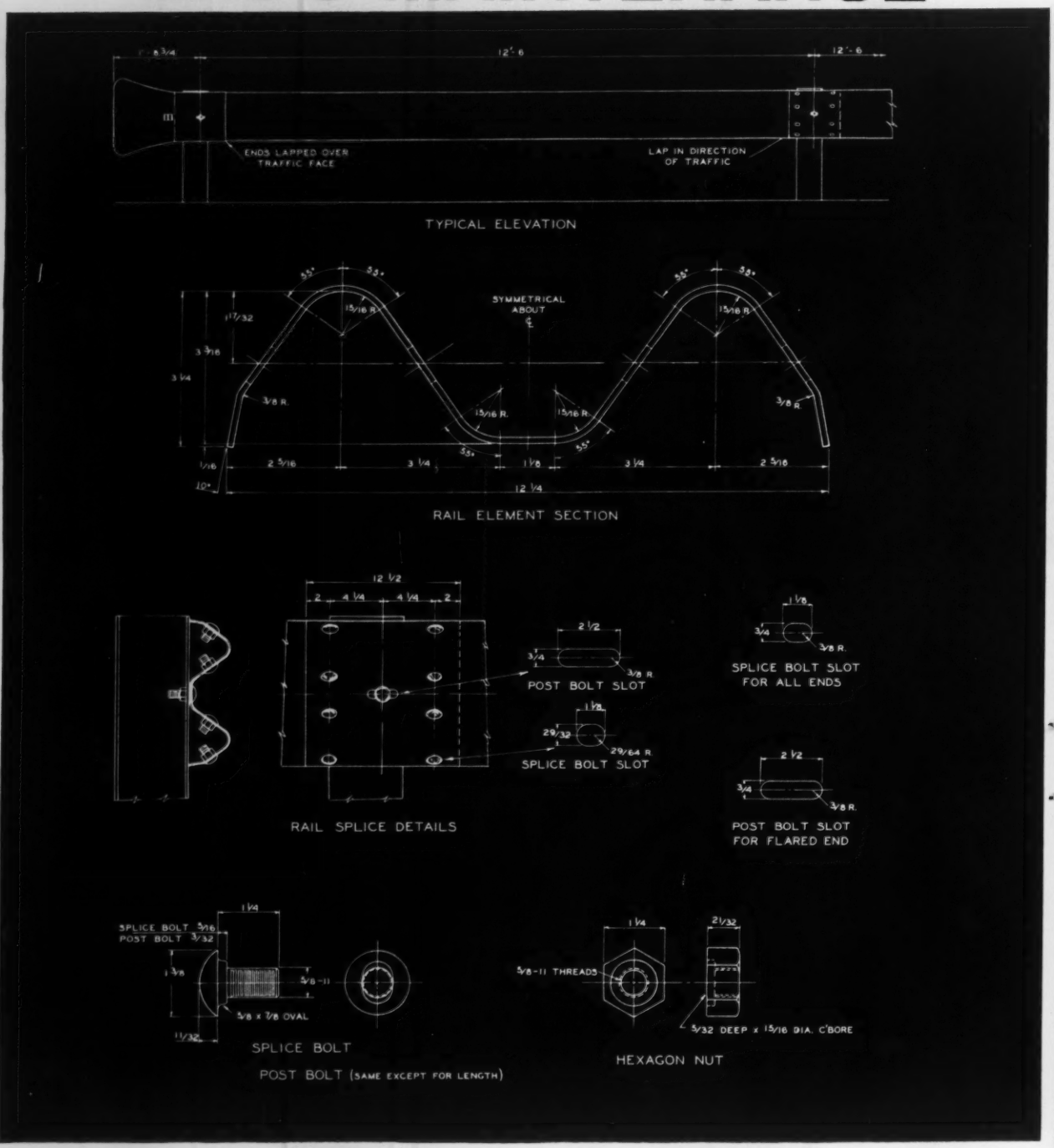
Caterpillar's multimillion-dollar research and development program—to meet the continuing challenge of the greatest construction era in history with the most productive earthmoving machines ever developed.

CATERPILLAR

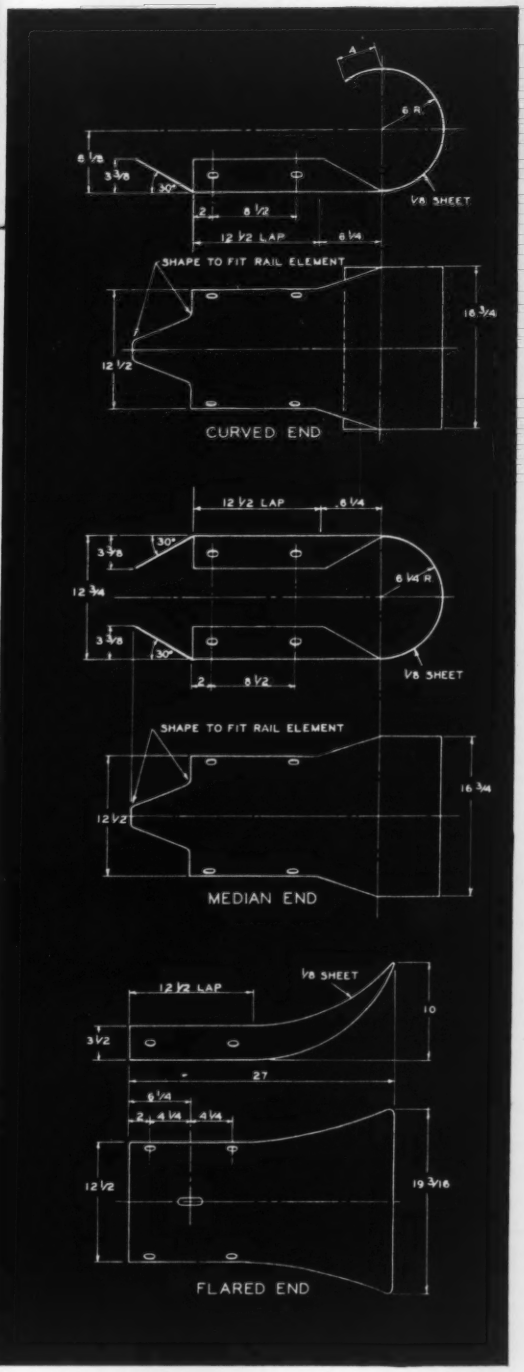
Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

BORN OF RESEARCH
PROVED IN THE FIELD

NEW ALCOA ALUMINUM BEAM GUARD RAIL ENDS MAINTENANCE



The story's in the "specs"



General. Alcoa® Aluminum Beam Guard Rail shall consist of rail elements fabricated to develop continuous beam strength and shall be installed as shown on the plans.

Description. The rail element shall consist of aluminum sheet formed into a beam not less than 12 in. wide and 3 in. deep, in accordance with the standard drawing. The cross section shall consist of two corrugations symmetrical about the horizontal axis, with the rounded faces turned toward traffic and the edges turned away from traffic. The edges and the center of the rail shall contact each post. Splices shall be bolted and lapped not less than 12½ in. Each end of every installation shall be fitted with a terminal section as shown on the standard drawing.

Material. The rail elements shall be formed from aluminum alloy Alclad 2024-T3 sheet (ASTM Specification B209, latest issue, alloy clad CG42A, condition T3). The terminal sections shall be formed from aluminum alloy Alclad 2024-O sheet (ASTM Specification B209, latest issue, alloy clad CG42A, condition O). All bolts shall be aluminum alloy 2024-T4 with 204 Alumilite* finish. The bolts shall be made from rod conforming to ASTM Specification B211, latest issue, alloy CG42A, and shall be supplied in the T4 temper. Bolt head and thread dimensions shall conform to the standard drawing.

All nuts shall be aluminum alloy 6061-T6 made from rod conforming to ASTM Specification B211, latest issue, alloy GS11A, condition T6. Nut and thread dimensions shall conform to the standard drawing.

Strength. The rail element shall be designed to meet the requirements of the following table. The post connection shall withstand a 5,000-lb side pull in either direction.

*Trade Name of Aluminum Company of America

Nominal Thickness in.	Minimum Tensile Strength of Joint lb	Beam Strength†			
		Traffic Side Up		Traffic Side Down	
		Load, lb	Max. Deflection in.	Load, lb	Max. Deflection in.
0.105	65,000	1,200 1,800	3½ 5½	1,000 1,400	3½ 5½
0.125	80,000	1,500 2,000	3½ 5½	1,200 1,600	3½ 5½
0.156	100,000	2,000 3,000	4 6	1,600 2,400	4 6

†With the rail element freely supported on a 12-ft 0-in. clear span and the load applied through a 3-in. flat surface at the center of the span.

Interchangeable Parts. Guard rail parts furnished under this specification shall be interchangeable with similar parts, regardless of the source or manufacturer.

Inspection. Guard rail parts shall be inspected to determine that the material dimensions and workmanship are in accordance with the standard drawing and this specification.

Installation. Posts shall be spaced on 12-ft 6-in. centers measured along the center line of the rail. The rail elements shall be lapped in the direction of traffic. When designated on the plans, the rail elements shall be curved before erection. Holes for special details may be field-drilled or punched, when approved by the engineer. Terminal sections shall be attached to the ends of each installation and shall be lapped on the face of the rail.

Painting. No painting of the aluminum guard rail elements, end sections or fasteners will be required.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

Your Guide to the Best in Aluminum Value

For Exciting Drama Watch "Alcoa Theatre," Alternate Mondays, NBC-TV, and "Alcoa Presents," Every Tuesday, ABC-TV

Aluminum Company of America, Dept. 1913-E
Alcoa Building, Pittsburgh 19, Pa.

Please rush complete details on Alcoa Aluminum Deep Beam Guard Rail!

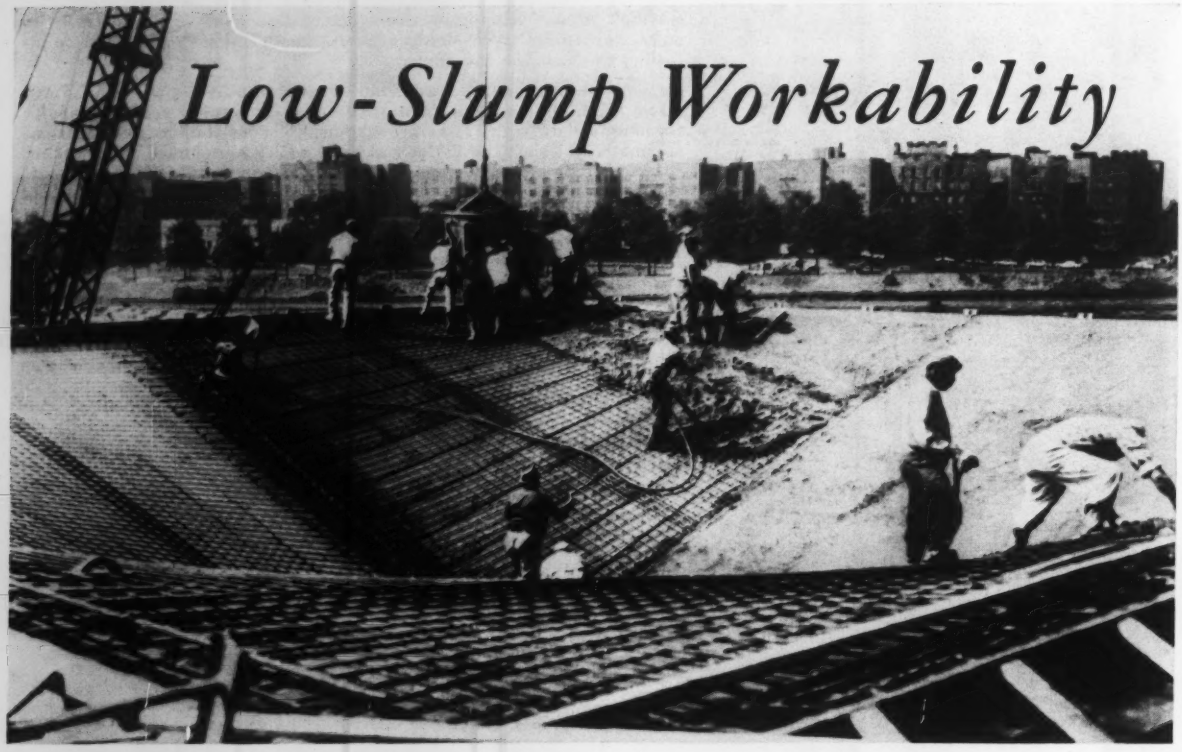
Name_____

Firm_____

Address_____

City_____ Zone____ State_____

Low-Slump Workability



This hyperbolic paraboloid, spanning 60 feet, is one of six for the new library of Hunter College, New York City.

...with PLASTIMENT

Architect:
MARCEL BREUER, FAIA
Consultant: Eduardo Catalano
Associate: Robert F. Gatje
Consulting Structural Engineers:
FELIX CANDELLA; FARKAS & BARRON
General Contractor:
LEON D. DeMATTEIS & SONS, INC.
Concrete Contractor:
DIC CONCRETE CORP.

The problem, to place lightweight Lelite concrete on steep slopes — as much as 45° — for the 3½ in. thick hyperbolic paraboloid roof of the new Hunter College library . . . Good workability at low slumps and a cohesive mix were vital . . . Plastiment retarding densifier, added to the mix, gave the desired workability at 2-inch slumps, and rapid clear-water bleeding for stability on steep slopes, resulting in sound concrete . . . Strengths of 3000 psi were obtained in 7 days.

Plastiment controls the hydration of cement by retarding and reducing cement gel formation . . . It does not entrain air so that proportions can be varied to meet job conditions . . . Workability is greatly increased so that even stiff mixes are readily compacted . . . In addition, it reduces cracking, increases strength and provides more uniformity in a concrete member.

Call Sika direct or nearest distributor for catalog and technical information and service.

Other Sika Admixtures:

SIKACRETE	SIKA AER	INTRAPLAST	SIKA NO. 1
Accelerating Densifier	Air Entraining Resin Solution	Expanding Grouting Aid	Integral for Cement Mortar

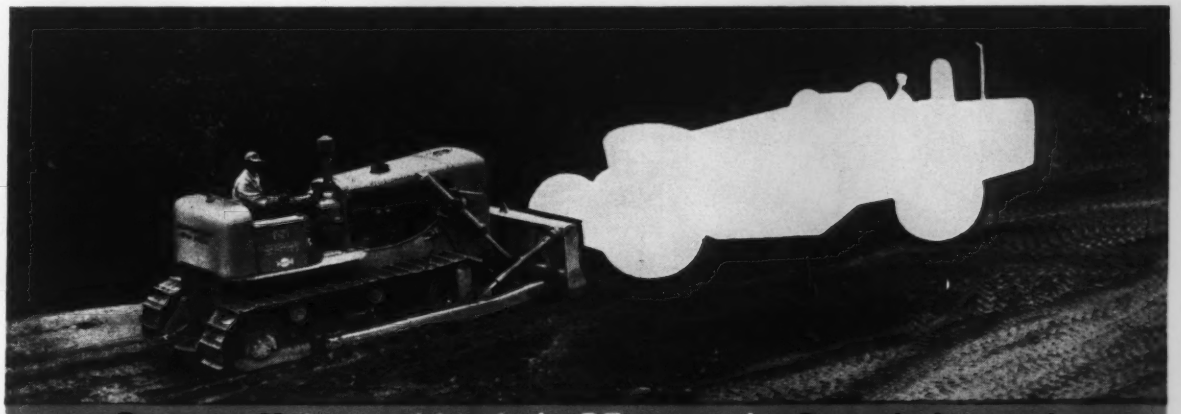
RELIABILITY • EXPERIENCE • SERVICE

Sika **SIKA CHEMICAL CORPORATION**
PASSAIC · NEW JERSEY
COMPOUNDS FOR MASONRY and CONCRETE CONSTRUCTION
DISTRICT OFFICES: ATLANTA • BOSTON • CHICAGO • DALLAS • DETROIT • NEW ORLEANS • PHILADELPHIA
PITTSBURGH • SALT LAKE CITY — DEALERS IN PRINCIPAL CITIES — AFFILIATES AROUND THE WORLD

Same cut... same pusher
5% more dirt in 42% less time

DAY IN... DAY OUT, THIS ALLIS-CHALMERS 9½-YARD TS-160 OUTWORKS ITS LEADING COMPETITOR... AND DELIGHTS ITS OWNER*

This is no demonstration setup. It's a road job* where these two self-propelled scrapers worked every day . . . push-loaded by the same Allis-Chalmers HD-16 torque converter tractor. That made every loading cycle about as identical as they'll ever get. And hour after hour, the TS-160 moved out of the cut with a heaped load in an average of 42% less time than its 9-yard companion of another make. *This is extra work power you can turn into profit!*



Scraper X, heaped loads in 35 seconds, 9 yards heaped

TS-160, heaped loads in 20 seconds, 9½ yards heaped

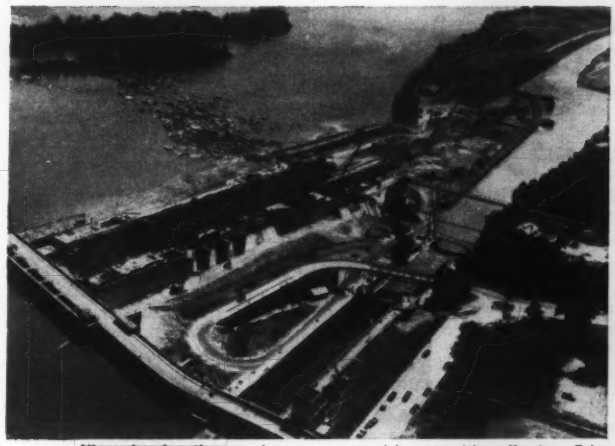
* Further details on request

You may be surprised . . . may even challenge these facts. But facts they are, and we invite you to check them on *your* job, with *your* stop watch. Call your nearby Allis-Chalmers dealer now. He'll provide the TS-160 . . . when and where you say. *Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wis.*

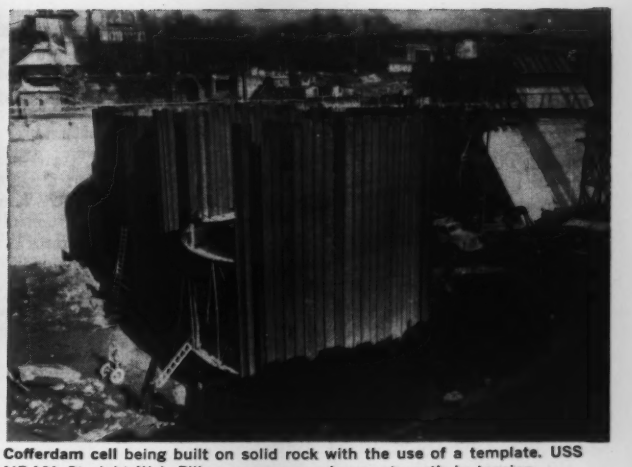
...move ahead with ALLIS-CHALMERS...power for a growing world

World's highest single-lift lock built with USS Steel Sheet Piling cofferdams

Downstream view showing new Wilson Lock with cofferdam A at left and E at the far end of the lock.



View showing the new temporary canal in use with cofferdam F in background shutting off the entrance of the old canal while it is being deepened by 10 feet.



Cofferdam cell being built on solid rock with the use of a template. USS MP-101 Straight Web Piling assures maximum strength in tension.

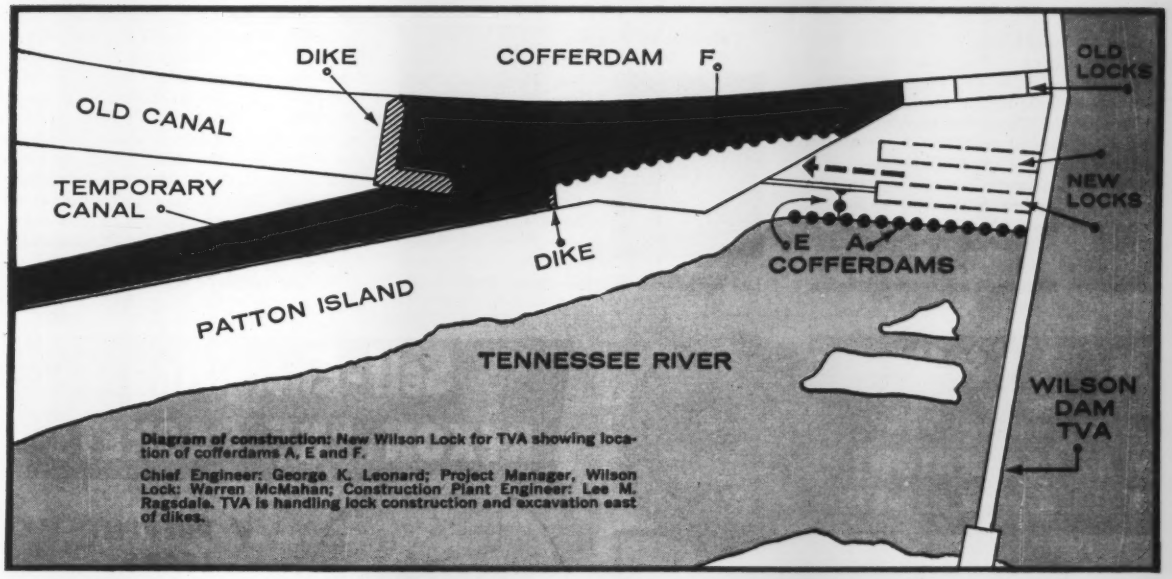


Diagram of construction: New Wilson Lock for TVA showing location of cofferdams A, E and F.

Chief Engineer: George K. Leonard; Project Manager, Wilson Lock: Warren McMahan; Construction Plant Engineer: Lee M. Ragsdale. TVA is handling lock construction and excavation east of dikes.

TVA's new 100-foot-high Wilson Lock at Muscle Shoals, Alabama will have the distinction of being the world's highest single-lift lock. The $35 million construction project includes a 110 x 600 ft. lock chamber through the existing dam, 4 million cubic yards of canal excavation, and a high-level fixed span bridge over the huge lock.

It is quite an engineering feat to construct a new lock through an old dam without interrupting navigation more than a few days. The first two cofferdams, A and E, were built to keep the Tennessee River out of the new lock area. These took a total of 32 cells, each 36.61 feet in diameter, with the USS MP-101 Straight Web Piling ranging from 38 feet to 48 feet in length. The cofferdams were set on rock; consequently, there was no penetration. It took an average of three days to construct and fill each cell.

Another cofferdam, F, was built to direct the flow of water into a new temporary canal through Patton Island and to dry up the old canal which will be made 10 feet deeper. The 58 cells in this cofferdam are 23.88 feet in diameter and are also set on rock. The piling is all in 20-foot lengths of USS MP-101. There was no penetration, and the cells were constructed and filled on an average of one per day.

A total of 3,953 tons of USS MP-101 Straight Web Piling was used for these three cofferdams—and all of it was delivered on schedule. For the new bridge (not shown), USS H-Beam Bearing Piles were used. This is another case that illustrates the excellent deliveries made possible by U. S. Steel's large production facilities and attention to customers' needs. When you want any type of piling—steel sheet piling or H-Beam bearing piles—call the United States Steel office near you.

USS is a registered trademark

United States Steel Corporation — Pittsburgh
Columbia-Geneva Steel — San Francisco
Tennessee Coal & Iron — Fairfield, Alabama
United States Steel Export Company

USS United States Steel

NEWS OF ENGINEERS

Thomas A. Lang, one of Australia's outstanding engineers and an authority on hydroelectric development, has joined Bechtel Corporation, international engineers and constructors with headquarters in San Francisco, as an executive engineer in the Power and Industrial Division. Mr. Lang has been associate commissioner of the Snowy Mountains Hydroelectric Authority, Cooma North, New South Wales, for the past ten years.

Karl M. MacDuffee, civil engineer with the Army Corps of Engineers, has retired after almost twenty-five years of government service. Much of Mr. MacDuffee's work with the Corps has been concerned with flood control problems in the Willamette Valley and lower Columbia areas, and spans a period when most of the big dams now operating in the Columbia Basin were being designed and built.

John W. Kinney, sanitary engineering consultant of Ann Arbor, Mich., has joined Goodkind & O'Dea as director of field operations. Mr. Kinney was resident engineer for the consulting engineer on the Mackinac Straits Bridge in Michigan from 1954 through 1958.

Ralph Cutler had been named a vice president of Yuba Consolidated Industries, Inc., and general manager of the Southwest Welding and Manufacturing Division. Mr. Cutler goes to Southwest Welding and Manufacturing, located in Alhambra, Calif., from the Kaiser Steel Corporation, Montebello, Calif., where he was manager of engineering and estimating for the fabricating division.

Coleman R. Sample, vice president of Ford, Bacon & Davis, Inc., has been elected a director of Ford, Bacon & Davis, Inc. and the Ford, Bacon & Davis Construction Corporation, New York City engineers and business consultants. Mr. Sample has been with the firm since 1918.

Fred E. Ressegieu, who joined the Bechtel Corporation, San Francisco, Calif., last year as an executive engineer, has been appointed manager of defense projects for the firm. From 1954 to 1957, as chief of the Plans and Programs Division, Office of Research and Development, Washington, D. C., he was responsible for planning and budgeting the Army's $400-million research program.

Charles A. Peters, for the past two years assistant to the Commissioner of Public Buildings, Washington, D. C., has retired from the Public Buildings Service after forty-one years in Federal service. In his long career Mr. Peters devoted his attention first to construction projects, including the White House reconstruction of the 1920's and the design and construction of the Lincoln Memorial reflecting pool, and later to the management of Federal buildings throughout the country. In 1956 he received the Distinguished Service Award, the highest recognition a civilian employe can receive.

SET UP IN SECONDS!
Set up OVER or UNDER a point with new
WARREN-KNIGHT TELE-PLUMB

No more trial and error, wasted time, building windbreaks for your plumb bob. Set up *fast*, directly over or under a point, with precisely accurate WARREN-KNIGHT TELE-PLUMB. Sight any set-up point, from nadir to zenith, through transit telescope that sights your line. Shift transit without disturbing level. See vertical wire cut set-up point with full power of transit telescope — far more accurate than any other type of optical plummet. Nothing to attach or detach between set-ups. TELE-PLUMB can be used on transits or transit-levels, fits most internal focusing telescopes. Order direct for Warren-Knight instrument, or write for full details, giving make, model and serial number.

Immediate, accurate set-up over or under any point.

OUR 51st YEAR

Ask for Bulletin CE-95 that lists Full Details

WARREN-KNIGHT
136 North 12th St., Philadelphia 7, Pa.

Self-Energizing
REXON "K" GASKETS

✓ PREVENT LEAKS

✓ SPEED PIPE-LAYING

REXON "K" *Rubber* Gaskets "pack" the pipe joint tight under compression, preventing leakage in or out of the pipe joint. Self-energizing action causes Gasket to seal even tighter as water pressure increases. Made for standard bell and spigot concrete pipe, REXON "K" Gaskets "snap-on" to the pipe, and the pipe is quickly coupled into the line. Wet trenches do not delay the work. Made of acid-resistant rubber, they never deteriorate. REXON No. 2 PIPE COATING protects concrete pipe against deterioration by hydrogen sulphide gas, oils, greases and solvents. It is synthetic hard rubber which vulcanizes to pipe by catalytic action, *not* by evaporation which causes pin-holes. WRITE FOR MORE DETAILS. 5104

HAMILTON KENT MANUFACTURING CO.
Kent, Ohio *ORchard 3-9555*

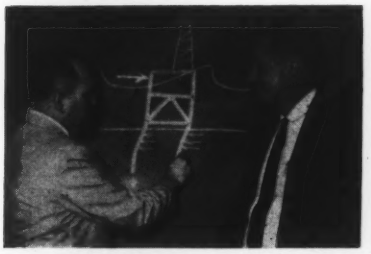
Serge Leliavsky, formerly chief of Designing Service in the Nile Barrages and Reservoirs Department of the Egyptian Government and now engaged in private practice in Cairo, has been invited by the Imperial College of Science and Technology, University of London, to give several lectures to advanced students and interested members of the public. The lectures to be delivered in May 1959, deal with uplift in gravity dams.

E. F. Bespalow, vice president and chief engineer of Choctaw, Inc., Memphis, Tenn., was reelected president of the American Concrete Pipe Association at its annual convention in Palm Beach, Fla., on March 14. He has been a leader in the association for many years, having served as director, vice president, and chairman of the Technical Problems Committee. Mr. Bespalow is past-president of the ASCE Mid-South Section.

Robert D. James has been assigned as a field service engineer in the A. M. Byers Company's Houston, Tex., Division Office. Before joining the Byers Company, Mr. James was employed by the Allis-Chalmers Manufacturing Company and the General Cable Corporation.

James A. Lindsey, founder of the firm of Lindsey Engineering Company, Hutchinson, Minn., in 1953, announces a new office location at 129 West Lake Street, Minneapolis 8, Minn. In 1957 Mr. Lindsey became the co-founder and president of the firm of Lindsey, Carter & Associates, Inc. The principals of that firm separated and the Lindsey Engineering Company has been reestablished.

Finley B. Laverty took over in February as assistant chief engineer of the Los Angeles Flood Control District in charge of the Dams and Construction Branch. Mr. Laverty is serving as Director of ASCE.



Two professors of civil engineering at the University of Texas—Lymon C. Reese (left) and Hudson Matlock—have been awarded a $20,870 grant from the university's first Excellence Fund to support their basic research on the movement of different soils as it affects both land and offshore structures. Here they explain one of the problems they will cover in the seven-month study.

Jack B. McKamey, since 1956 construction manager of Ebasco Services Incorporated, New York, N. Y., has been appointed a member of the Atomic Energy Commission's Fluid Fuel Reactors Task Force. Mr. McKamey is especially qualified as industry representative on the task force because of his experience in manufacturing, invention research and development, construction of nuclear facilities, and business organization and management.

M. J. Shelton, formerly deputy director of the California State Division of Water Resources at Sacramento, has become connected with Koebig and Koebig, consulting engineers-architects. He will be chief engineer of the firm's newly opened office in San Diego.

John C. Lamb, III has been appointed associate professor of sanitary engineering in the University of North Carolina's Department of Sanitary Engineering of the School of Public Health at Chapel Hill. Since 1955, Dr. Lamb has been serving as a sanitary engineer with American Cyanamid Company, in Bound Brook, N. J. In addition to his teaching, he will be in charge of research work being sponsored by the Mead Corporation on the chemistry of pulp mill wastes.

Jack E. Rosenlund, chief structural engineer for George L. Dahl, architects and engineers of Dallas, Tex., was recently honored with a bronze plaque by the American Concrete Institute. The honor was accorded him for his published treatise on the details and problems of forming the columns, cantilevers, and roof sections governing the structural design of the Dallas Memorial Auditorium.

Grover L. Rogers, professor of civil engineering at Virginia Polytechnic Institute, has accepted the post of director of the department of engineering science in the College of Arts and Sciences at Florida State University in Tallahassee, effective July 1. Dr. Rogers' new book, "Dynamics of Framed Structures," will be published in June 1959.

Spencer, White & Prentis, Inc., are opening a district office in Pittsburgh, Pa. The firm, specialists in foundation work and heavy construction throughout the U. S., maintain district offices in Chicago, Detroit and Washington, D. C. The main office is in New York City.

Ven Te Chow, professor of hydraulic engineering at the University of Illinois, has been named an engineering consult-

(Continued on page 26)

TUBULAR *RAILINGS*

Pictured is one of the many types of Tubular Railing. This railing is made from a combination of standard pipe and square and rectangular tubing. Its design offers extra strength and durability with many years of service—at minimum maintenance. For superior design and quality construction, specify Tubular Railing on your job.

TUBULAR Products, Inc.

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There's a KERN SURVEYING INSTRUMENT *to Serve* Your Every Need

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There's a KERN REPRESENTATIVE in Your Area... *to Serve* YOU!

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120 Grand St., White Plains, N.Y.

News of Engineers

(Continued from page 25)

ant by the Mayor and Board of Supervisors of the City and County of Honolulu, to review the design criteria for proposed drainage and flood control projects on the Island of Oahu.

Fozi M. Cahaly, Leon B. Turner and **Harold H. Jones,** directors of Fay, Spofford & Thorndike, Inc., Boston, Mass., are among the firm's newly appointed vice presidents. Mr. Cahaly is an expert in the field of sanitation; Mr. Turner supervises production work for all the firm's projects; and Mr. Jones is a specialist in highways and military bases.

Palmer J. Langteau has been named a foreman in the power house at Allis-Chalmers' West Allis Works. Mr. Langteau is a civil engineering graduate of Marquette University and recently completed Allis-Chalmers training course for graduate engineers.

George C. White, district manager of the San Francisco Division of Wallace and Tiernan, Inc., has been promoted to manager of the Chlorinator Division for the United States and Canada, with headquarters in New York City. Before joining Wallace and Tiernan in 1938 as service engineer, **Mr.** White was employed by the Metropolitan Water District of Southern California and by TVA on aerial mapping projects.

Perry, Lamprecht & Rickert, consulting structural engineers, have moved to their new office at 2443 North Calvert Street, Baltimore 18, Md.

Harold S. Floyd, until recently assistant to the construction manager at Ebasco Services, Inc., New York, N. Y., has been made manager of the firm's construction office.

Luther E. Olson is vice president of the newly formed Rome Industrial Development Corporation, Rome, N. Y. Mr. Olson recently retired as executive vice president of the Gillmore-Olson Company, engineers-builders of Cleveland, Ohio. Since founding the firm in 1919, he has been active in designing and building industrial plants for such nationally known firms as Union Carbide Corporation, General Motors, Kennecott Copper, Thatcher Glass, Allegheny-Ludlum Steel Company and American Optical Company.

John D. Watson announces the dissolution of the engineering firm of Watson and Hart, in practice at Greensboro, N. C., since 1946. Mr. Watson will continue structural, mechanical and electrical engineering at the firm's local office under the name of Watson Engineers.

A. Carl Weber, director of research and sales engineering for the Laclede Steel Company, St. Louis, Mo., received one of the first Engineers' Day Honor Awards presented by the Washington University School of Engineering, St. Louis, on March 13. Mr. Weber was one of three outstanding alumni of the Washington University School of Engineering to receive the awards.

Thomas C. Shedd, professor emeritus of structural engineering at the University of Illinois, has become an associate, of Clark, Daily and Dietz. The firm has offices in Champaign-Urbana, Ill.; Memphis, Tenn.; and Carlyle, Ill. Mr. Shedd joined the staff of the University of Illinois as an associate in structural engineering in 1922.

William G. Gerry has been appointed general manager of Terra Engineering Laboratories, Ltd., Victoria, B. C. Mr. Gerry, until recently construction department engineer and assistant superintendent with the Saguenay-Kitimat Company, will supervise Terra Engineering Laboratories' operations in British Columbia, Alberta, and the Northwest Territory.

Leo W. Ruth, Jr., partner in the San Jose (Calif.) civil engineering firm of Waters, Ruth and Going, has been named to the California State Board of Registration for Civil and Professional Engineers. He succeeds **William T. Wright,** of the Los Angeles architectural-engineering firm of Kistner, Wright & Wright. Mr. Wright, who resigned on March 13, has served as civil and structural engineer member of the Board since 1953.

Joe E. Thompson has been named assistant chief engineer of the Natural Gas Pipeline Company of America in Chicago. Mr. Thompson was superintendent of pipeline construction for six years prior to his promotion.

James A. Higgs, former Director of ASCE, has retired as district sales manager of the American Marietta Company's Concrete Products Division at Atlanta, Ga. Mr. Higgs was ASCE Director for the 1952-1954 term.

Melvin J. Greaves has been appointed chief engineer of the Metals Division of Arthur G. McKee & Company in Cleveland, Ohio. Mr. Greaves joined the McKee Company in 1956 as a development engineer, becoming assistant chief engineer of the Metals Division the following year. At one time he was professor of engineering at Utah State University.

(Continued on page 118)

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OPEN TO ALL: Engineering undergraduates and graduate students, faculty, and practicing engineers. This competition invites papers which will promote ingenuity, originality, and research in the field of foundation engineering as related to the *foundations of structures*. Any aspect of this broad field, theory or practice, is a fit subject. Deadline for all papers is September 1, 1959.

THE JUDGES E. A. DOCKSTADER, Consulting Engineer, West Newton, Massachusetts.

WILLIAM W. MOORE, Partner, Dames & Moore, Consulting Engineers, San Francisco, California.

RALPH B. PECK, Professor of Foundation Engineering, University of Illinois, Urbana, Illinois.

"These awards by Raymond International Inc., are a step in the right direction. By lending encouragement to research in the foundation field, they can stimulate interest in civil engineering research generally. More of it must be done if the art of construction is to advance."

—Waldo G. Bowman, Editor, Engineering News Record, December 25, 1958.

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. . . . . Am-Soc Briefs

▶ ▶ Cincinnati is in the news as the first city in the country where local sections of all the Founder Societies have met their quotas in the fund drive for the United Engineering Center. ASCE's Cincinnati Section, under Prof. Cornelius Wandmacher, has already topped its quota by 138 percent. Richard E. Dougherty, chairman of the National Member Gifts Campaign, sees Cincinnati's successful drive as the direct result of that city's "long history of excellent engineering society organizations."

▶ ▶ Another Ohio city — Cleveland — has just hosted the 1959 Nuclear Congress, which drew thousands of engineers (among them, 2,000 students) interested in the part they will be called on to play in the rapidly expanding atomic power industry. . . . The 1960 Nuclear Congress, with ASCE the managing society, will be especially concerned with the civil engineer's role in the nation's atomic program.

▶ ▶ Surveyors are engineers. . . . Recommendations of the Task Committee on Status of Surveying and Mapping, presented at the Annual Convention in New York last fall, have now been adopted as Society policy by the Board of Direction. Classifications of four major surveying and mapping categories are given in the Society News section.

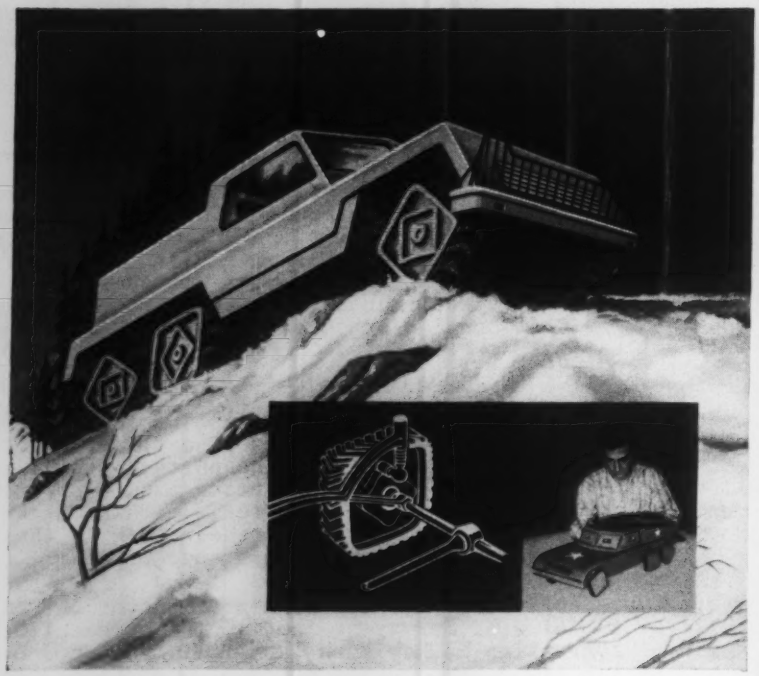
▶ ▶ This month the Society's Engineering Salary Index shows new returns — the result of a survey of representative consulting firms and highway departments launched January 31. The survey, which is now prepared semiannually, is intended merely to show salary trends.

▶ ▶ ASCE on the alert . . . . The Society is protesting an engineering fee limitation proviso in a Department of the Interior appropriations bill, HR 5915 (Society News). . . . Agencies asking bids on surveying are being advised of the ASCE position that much of such work is professional and should be arranged for through negotiation. . . . On the education front, the Society is co-sponsoring an exchange of U.S. and Russian soil mechanics and foundation engineers this summer. The other sponsors are the Highway Research Board and the U.S. National Council on Soil Mechanics and Foundation Engineering.

▶ ▶ The June issue of Civil Engineering will feature the $10,000,000 plant for Glen Canyon Dam with its impressive array of largest-ever items. . . . two 50-ton cableways to handle 12-cu-yd buckets of concrete, a 217-ft-high concrete plant with 3,000-ton storage and six 4-cu-yd mixers, the ice plant with higher capacity for cooling concrete, than any commercial installation, and a 23,000-hp construction power plant.

▶ ▶ ASCE Treasurer Charles Trout is dead at 87. . . . The headquarters staff is saddened by the death of Charles E. Trout, veteran Society member and long-time treasurer, in New York on April 19. His obituary will be in the June issue. Mrs. Trout has suggested that engineers wishing to honor his memory can most effectively do so by contributing in his name to the United Engineering Center fund.

No. 14 • Mars Outstanding Design Series

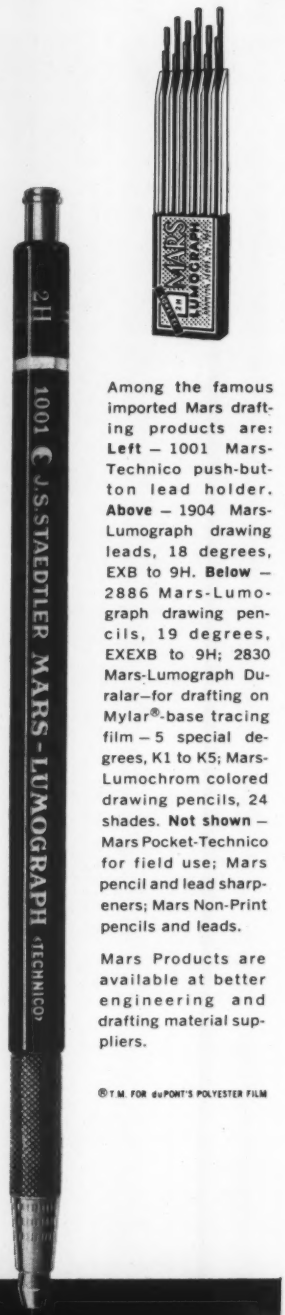


SQUARE WHEELS? Yes ... square wheels. Operating by means of a floating axle and cam gear, they take the bumps out of rough terrain and provide more traction. U.S. Patent No. 2786540 has been granted to designer Albert Sfredda of Bethlehem, Pa., for his invention.

The square shape gives superior traction in mud, sand, snow or uneven terrain. The flat surfaces of the wheels bridge the ruts instead of sinking into them as do round wheels. The wheels can be in any relative position, do not need to be synchronized—yet they run smoothly. Designed for use on heavy trucks, jeeps, farm or construction machinery, speeds up to 35 miles per hour can be attained.

This ingenious departure from age-old precedent is just one example of the contributions that today's designers are making. To help them translate their pace-setting ideas from concept to reality they require the best of drafting tools.

In pencils that means MARS, long the standard of professionals.



Among the famous imported Mars drafting products are: **Left** – 1001 Mars-Technico push-button lead holder. **Above** – 1904 Mars-Lumograph drawing leads, 18 degrees, EXB to 9H. **Below** – 2886 Mars-Lumograph drawing pencils, 19 degrees, EXEXB to 9H; 2830 Mars-Lumograph Duralar—for drafting on Mylar®-base tracing film – 5 special degrees, K1 to K5; Mars-Lumochrom colored drawing pencils, 24 shades. **Not shown** – Mars Pocket-Technico for field use; Mars pencil and lead sharpeners; Mars Non-Print pencils and leads.

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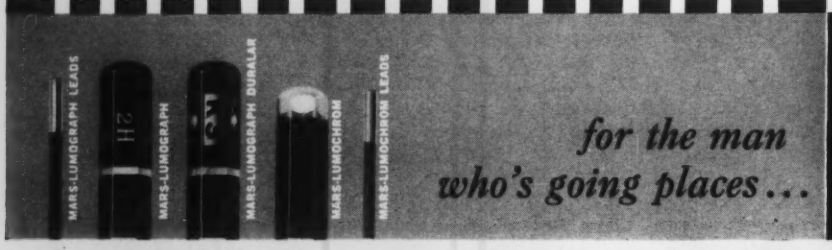

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do you know that

The wing span of today's giant jets is greater than the entire distance flown by the Wright brothers in their first successful flight? Since the historic day at Kitty Hawk, less than sixty years ago, flying has probably changed the world more than any other single development. This issue is devoted to the new era of jet aircraft and the construction problems involved in making travel by jet safe and efficient.

▪ ▪ ▪

Today New York is closer to Bombay in travel time than it was to Boston in Colonial times? While it took Columbus 70 days, the Mayflower 97 days, and Lindbergh 33½ hours to cross the Atlantic, seven hours are now standard for the New York-to-Paris trip by jet. The implications of such speed are far reaching. In a single month, for instance, one of the new jets can carry 20,200 passengers from the East to the West Coast, compared with the 6,000-passenger capacity of a train in the same period.

▪ ▪ ▪

By the end of the year 30 percent of all flying will be in turbine-powered craft? The airlines also estimate that by 1961 the new jets will be the basic commercial aircraft. By 1965, the Civil Aeronautics Administration predicts, the airlines will be carrying 93,000,000 passengers annually, almost twice the number transported in 1957.

▪ ▪ ▪

Jet aircraft are gaining favor for corporation use, too? Private companies are beginning to utilize turbo jets and pure jets for the business trips their executives make on the theory that they are more comfortable as well as speedier. Thirteen of the big fast planes are already in use, and fifty firm orders have been placed by companies all over the country. The average jet for executive transport accommodates from ten to twenty passengers, speeds them on their way at from 300 to 600 mph, and sells for from $750,000 to $1,000,000.

▪ ▪ ▪

Chicago's Midway Airport continues to be the busiest in the country? With 419,690 plane operations in the 1957-1958 fiscal year, it topped all others in the country. The Miami Airport, with 346,122 plane operations, was second, followed closely by the Los Angeles Airport with 322,192 movements. Phoenix's Sky Harbor Airport, with 310,400 landings and takeoffs, moved into fourth place ahead of Dallas, which had 305,800 traffic operations. Albuquerque, N. Mex., with 304,348 traffic movements, was in sixth place; New York's La Guardia Field, with 285,603 operations, in seventh place; and Denver, Colo., with 282,493 movements, in eighth place. These figures were assembled by the Federal Aviation Agency and brought to our attention in a recent issue of the Arizona Section's newsletter.

▪ ▪ ▪

Our first commercial jet airport outside the continental U.S. is being built in our fiftieth state? Hawaii's huge new construction program includes a $25,000,000 overhaul of the Honolulu International Airport to adapt it to use by jet planes. Work has already started on a new terminal building and completion of the project is set for late 1960. A new airport in Samoa and one in Tahiti are on the Outer Pacific construction agenda.

▪ ▪ ▪

Mobile lounges will expedite passenger handling at Washington International Airport? The new passenger-handling system devised for the big airport under construction at Chantilly, Va., will transport passengers from terminal entrance to plane in comfortable, air-conditioned mobile lounges, cutting distance walked from 950 to 350 ft. The idea was developed by Ammann & Whitney, prime consultants on the project, and the associated engineering and architectural firms.

▪ ▪ ▪

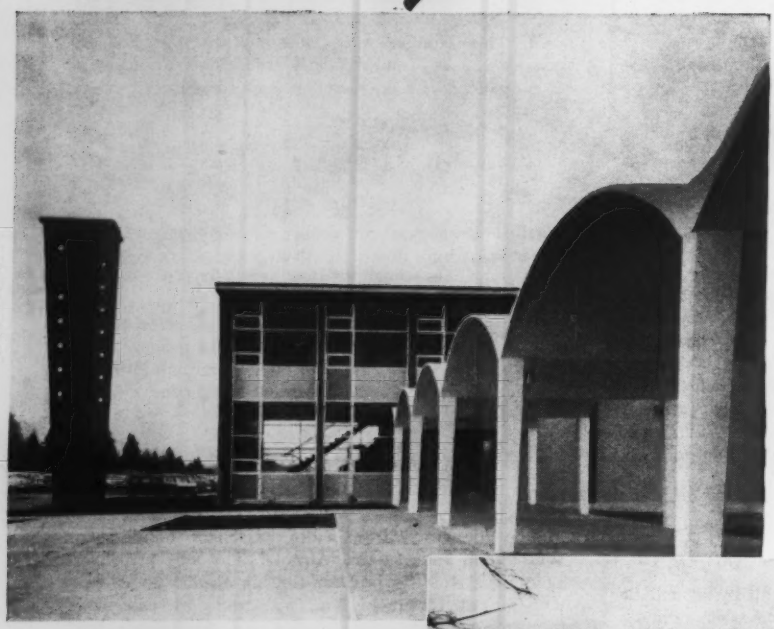
Between now and 1962 some $1.3 billion in improvements will be needed at 3,324 U.S. airports? About half the improvements are required to meet the needs of jet aircraft. These facts are brought out in the Federal Aviation Agency's new National Airport Plan, which outlines the public airport needs of all segments of civil aviation in the U.S. and its island possessions for the 1959-1962 period. The 500-page volume is for sale by the U.S. Superintendent of Documents (Washington 25, D. C.) at $4.75

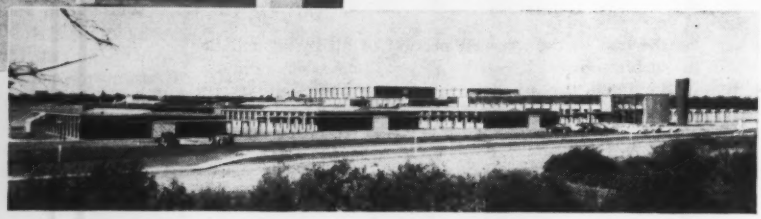
▪ ▪ ▪

ASCE is sponsoring its second Jet Age Airport Conference this month? The dates, May 20-22; the place, the Shamrock-Hilton Hotel in Houston; and the sponsors, the Air Transport Division and the Texas Section's Houston Branch. The program was in the April issue. The conference will be a fine chance to bone up on some of the most exciting developments of this exciting century.

TACOMA Rings the Bell!

New High School of Precast and Prestressed Concrete Scores in Firesafety, Beauty and Economy





● "As close to perfection as one could desire for student evacuation and for reducing the spread of fire." That's how the head of Tacoma's Fire Prevention Bureau described this new, all-concrete Woodrow Wilson High School. He added that this type of construction is recommended by the National Fire Protection Association for reducing life and property loss.

A product of 100% local resources, the school's 12 buildings and covered walkways put more than five acres under concrete roofs. Yet its final contract cost of $2,833,403 was only $14.06 per square foot, including such "extras" as sidewalks, paved parking areas, concrete tunnels for utilities, landscaping, architects' fees, and a year-round Olympic-size swimming pool!

Detailed cost comparisons, including savings on insurance premium costs, led to concrete construction. Among the 491 prestressed concrete girders were 105-foot spans over the gymnasium—the largest prestressed beams in the Pacific Northwest. All columns, tilt-up wall panels, walkway frames, and some 6,000 channel roof slabs were precast at the job site. 'Incor' was used exclusively in all prestressed members, and Lone Star Portland in all other concrete work.

Yes, Tacoma has rung the bell with this prefabricated concrete school. For whom does the bell toll? School authorities across the nation, faced with demands for safer schools and greater economy—may well heed the ringing!

WOODROW WILSON HIGH SCHOOL
Tacoma, Washington

Architect:
LEA, PEARSON & RICHARDS

Structural Engineering:
ANDERSON, BIRKELAND & ANDERSON

General Contractor:
NELSON CONSTRUCTION COMPANY

Prestressed Concrete:
CONCRETE TECHNOLOGY CORP.

Subcontractor, Concrete:
GEORGE MADSEN CONSTRUCTION CO.

Ready Mix Concrete:
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BETTER AIRFIELDS for BIGGER AIRCRAFT

Mission of ASCE Air Transport Division

This issue, devoted to the important part the civil engineer plays in the design and construction of airports and airfields to accommodate the large and heavy jet planes now coming into use, has been made possible by the active cooperation of the Society's Air Transport Division. Reginald J. Sutherland, Secretary of the Division, and Director, Airport Flight Facilities Development, American Airlines, arranged for many of the articles.

JOHN M. KYLE, JR., M. ASCE,
Chairman, Executive Committee, Air Transport Division,
Chief Engineer, Port of New York Authority, New York, N. Y.

With the organization of the Air Transport Division in 1945, the civil engineering profession assumed its rightful position of leadership in furnishing a central clearing house for the problems of providing adequate facilities for the handling of aircraft on the ground. Before that time, the only responsible mediums for the interchange of technical ideas in the air transport industry were the divisions, committees, and publications of the Armed Services and the Civil Aeronautics Administration. Even in the design of civil engineering facilities for air transportation, this interchange had been readily accomplished by these media not only within the Services but also by joint committees of each Service. Under this cooperative effort, giant strides were made in the standardization of air transport facilities.

At the end of World War II, when most of the engineers engaged in the design and construction of airports returned to private industry, the common meeting ground for discussion, and more important, the decision-making apparatus, disappeared. To fill the resulting void, a group of ASCE members organized the Air Transport Division.

From its start in 1945, this Division has expanded to a membership of 823 and five technical committees. By the standards of the longer established Divisions, it has contributed only a few technical papers. However, some of these papers have had a profound effect on the design and construction of airports throughout the world.

Probably the Division's greatest contribution to date was the organization of the First Jet Age Airport Conference held in New York in May of 1957. At that time, the industry was about to introduce jet aircraft into commercial use. The papers at that convention covered the fields of fueling, paving, noise and terminal operation, as well as the economic aspects of airport financing. The meeting also brought forth from the aircraft industry valuable data on the capabilities and performance of the newer jet planes in so far as these would affect planning for the airports of the future.

The Air Transport Division has always been fortunate in attracting to positions of responsibility a cross-section of the aviation industry. From the theoretical approach represented by educators, to the truly practical approach of those responsible for the actual construction and operation of airports, the Division has been able to draw upon the abilities of engineers with broad experience and a vital interest in this most complex problem.

During the past year, three new subcommittees have been set up in the Air Transport Division to further expand the services it furnishes. An article by the chairman of each of these committees appears in the following pages. The areas covered are fueling, hangars and landing facilities for steep-gradient aircraft such as helicopters, converter and vertical take-off planes. The treatment given the subjects clearly indicates the close collaboration between the civil engineer and his counterparts working on the aircraft and on the mechanical equipment associated with servicing them. As other areas require more complete coverage, it is proposed to set up committees of experts to assemble and correlate the basic data needed.

The cooperation the Air Transport Division is receiving from professional engineers in related fields is gratifying. It is essential that this close relationship be maintained as the lead-time on new and improved aircraft very closely approximates the lead-time required by the operator to make the landing area ready for the new, faster, heavier, and more complex aircraft of the future. The Air Transport Division is aware of this problem and has developed a close liaison with the designers of the various aircraft manufacturing companies.

Now that commercial jet planes are in actual operation, the Second Jet Age Airport Conference in Houston, Tex., May 20-22, 1959, should serve as a clearing house through which civil engineers working on air transport facilities can bring themselves up to date on the latest developments and trends that will affect the airports of the future.

G. C. MILLER, Airways Engineer, Thomas B. Bourne Associates, Inc., Washington, D. C.

Airport master planning for the jet age

The dawn of the Jet Age in commercial aviation this past winter has a special meaning for the civil engineer. One of his jobs, the design and construction of civil airports, is directly affected. In preparing plans for these airports he must consider many factors—among them the use of supersonic airliners already on the drafting boards, and the subsonic jets and turbo-prop aircraft now coming into general use.

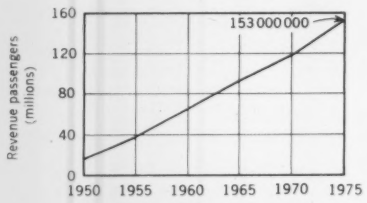
Several "firsts" occurred when the Boeing 707 Jet Airliners went into regular scheduled passenger service: intercontinental service by Pan American World Airways, New York to London, 6½ hours; medium-haul domestic service by National Airlines, New York to Miami, 135 minutes; and transcontinental domestic service by American Airlines, Los Angeles to New York, 4½ hours.

In preparing a master plan for a community airport, the engineer will find it helpful to divide the work into two phases—the feasibility study and the master plan.

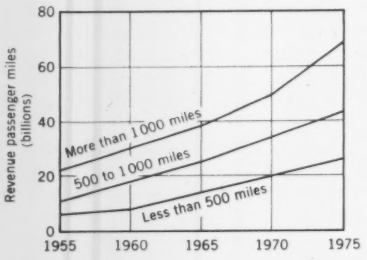
The feasibility study

The feasibility study cannot be discussed in detail here. Suffice it to say that the methods of preparing it follow the normal pattern of preliminary studies for such facilities as made by engineers and economists experienced in this field. In projecting current requirements into the future, it is necessary to lean heavily on the technical data and forecasts prepared by recognized authorities. Such sources include the "Curtis Report"; the Federal Aviation Agency (FAA), formerly the CAA; the International Civil Aviation Organization (ICAO); the "Doolittle Report"; the Interdepartmental Air Coordinating Committee; and data from the U. S. Air Transport Association, the International Air Transport Association and other aviation organizations. Representative examples of the type of information available are given in Tables I and II. It is estimated that total transport aircraft movements will increase from about 7 million in 1956 to 12 million in 1965 and nearly 15 million in 1975.

Our firm, Thomas B. Bourne Associates, has planned and designed some eighty military and civil airfield installations—in the United States, including Alaska, and abroad. The more recent of these were developed to meet the requirements of jet aircraft. Our concepts of design criteria for Jet Age airports are based on this experience and the consideration of modern philosophies developed by the several



FORECAST, domestic revenue passengers



FORECAST, revenue passenger miles

TABLE I. Forecast on composition and use of the air carrier fleet (transport)

Aircraft	Percentage of Fleet		
	1956	1965	1975
Small, less than 50 passengers:			
Piston	54	20	9
Turbo-prop	1	21	12
Turbo-jet	0	0	0
Totals	55	41	21
Medium, 50 to 100 passengers:			
Piston	45	9	4
Turbo-prop	0	24	28
Turbo-jet	0	11	13
Totals	45	44	45
Large, over 100 passengers:			
Piston	0	0	0
Turbo-prop	0	0	0
Turbo-jet	0	15	34
Totals	0	15	34

TABLE II. Forecast on composition and use of general aviation fleets

Hours in millions, number of aircraft in thousands

	1954		1960		1965		1970		1975	
	Hr	Aircraft	Hr	Aircraft	Hr	Aircraft	Hr	Aircraft	Hr	Aircraft
Business*	3.9	20.9	5.8	27.6	7.8	35.5	10.0	42.6	12.6	50.5
Commercial†	1.8	8.6	2.5	11.4	3.0	13.6	3.7	16.8	4.4	20.0
Instructional	1.3	5.3	1.5	6.0	1.7	6.8	1.9	7.6	2.0	8.0
Pleasure	1.9	26.5	2.3	21.6	2.5	19.3	2.8	18.9	3.2	19.0
Totals	8.9	61.3	12.1	66.6	15.0	75.2	18.4	85.9	22.2	97.5

*Not "for hire," used by corporations and individuals in the furtherance of their business.
†"For-hire" transportation of passengers and things, taxi service, charter service, survey, forest patrol, agriculture, etc. Does not include the Air Carrier Fleet.

groups that are nationally recognized as competent in the field of aviation facility planning.

The end result of the feasibility study is the "recommended action," which is the most difficult part to prepare, since it involves the prediction of future airport requirements. As General Quesada, Administrator of FAA, has pointed out, aviation planners have invariably underestimated the progress of aircraft design and future air-facility requirements. Looking back over aviation history and noting some of the representative types of aircraft in use at the beginning of 20-year periods, we find:

1898, free balloons and some primitive gliders

1918, war planes performing the functions of cavalry

1938, the DC-3 airliner of 28,000 lb, 175 mph

1958, the DC-8 and other subsonic jet airliners weighing close to 300,000 lb

In none of these periods could the planners of the day have accurately predicted progress in the next 20-year period. It seems that requirements can be forecast for 10 or 15 years with a fair degree of accuracy, but 20 years is below the horizon of our aviation vision.

The history of airport planning in the Nation's Capital is a fair example. In 1938 the design and location of the present Washington National Airport was in the planning stage. Washington Hoover Airport, built during the "boots and goggles" days of the 1920's, had been found inadequate to meet the needs of transport aircraft such as the then new DC-3. The judgment of the airport planners was seriously questioned; it was said that the proposed terminal building was entirely too large and would never be used to capacity, that the runways were too long and would never require extension. As for the suggestion that the field be located at Camp Springs, where adequate space was available for future expansion, it was shouted down because of the distance, it being all of ten miles from downtown Washington.

Had the planners evisioned the DC-8 of 20 years later and planned the 9,700-acre parallel-runway airport now under construction at Chantilly, some 25 miles from Washington, I am sure it would have been their sanity rather than their judgment that would have been questioned. The terminal building and hangar spaces at Washington National were soon found inadequate and had to be expanded. Within 20 years the entire installation was found unsuitable for use as a Jet Age air terminal by reason of its size, runway lengths and location within the city. Now the jet airliners will be forced to use the Baltimore airport pending the completion of Washington's International Airport at Chantilly.

The master plan

In preparing the master plan, I do not believe it is possible to forecast the types and characteristics of the aircraft that will come into use as far in the future as 1978. Rocket power, atomic-powered and outer-space ships may be within the aeronautical engineer's line of vision, but they are well below the civil engineer's horizon. However, I strongly feel that there are three main trends that will have to be provided for by the master planner during the next ten to fifteen years: (1) the skyrocketing increase in the number of aircraft movements in and out of airports in both airline and business-commercial aviation (Tables I and II); (2) the transition from piston airliners to turbopower (Table I); and (3) the normal increase in sizes and weights of aircraft and the advent of supersonic jet-airliners which, as always, will follow military progress.

Three major innovations in airport design appear necessary to meet these trends:

1. A drastic revision of runway configuration, taxiway systems, and loading positions to provide expeditious and economical handling of aircraft from the point of landing, through the gate-loading position to the point of take-off.

2. Expansion of the present parallel dominant runway configuration to provide a companion runway system so that simultaneous landings can take place on one pair of runways while simultaneous take-offs are being carried out on the other pair of runways.

3. Use of arresting gear for landing and power assist for take-off, for the larger aircraft. Such facilities, used in naval aviation for more than 35 years, make possible the operation of jet bombers from the great aircraft carriers of today. Longer and longer runways are continuously being required to meet the landing and take-off characteristics of new aircraft. Present runway lengths of 10,000 ft at sea level may have to be increased to 15,000 when altitude and gradient corrections are applied but this is about the economic and practicable limit.

In developing the master plan, it is wise to concentrate on designing facilities to meet the requirements of the larger jet airliners. Such facilities, with a few minor exceptions, will more than meet the needs of the smaller piston,

FIG. 1. Space requirements for maneuvering jet aircraft are indicated schematically. New Boeing and Douglas Turbojets have wing spans and lengths of 140 to 150 ft, wingtip turning diameters in the neighborhood of 200 ft, and single wheel loads of around 45,000 lb. Exhaust blast intensities are diagrammed below.

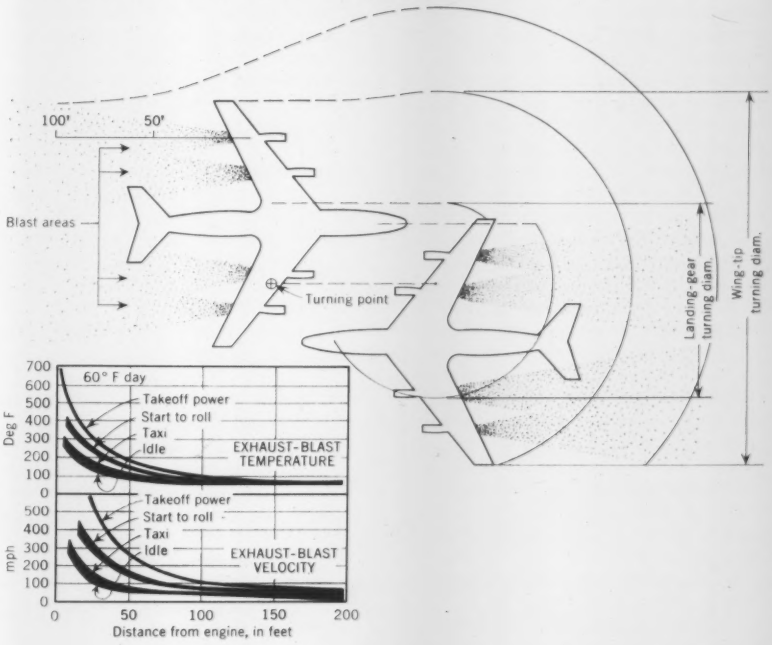
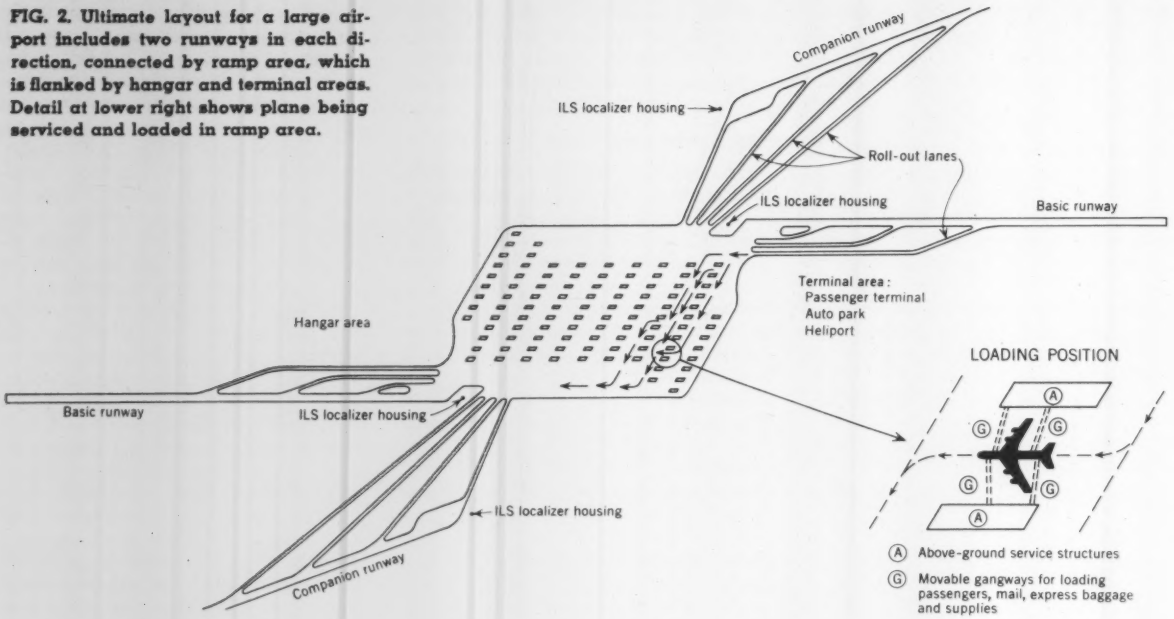


FIG. 2. Ultimate layout for a large airport includes two runways in each direction, connected by ramp area, which is flanked by hangar and terminal areas. Detail at lower right shows plane being serviced and loaded in ramp area.



turbo-prop and turbo-jet aircraft. The jet airliner has characteristics that require particular consideration:

1. The maximum take-off weight and resulting equivalent single-wheel loading determines pavement specifications, while wing span and length determine the size of the loading position.

2. The design of service structures adjacent to loading positions will be determined by the position, number and height of the aircraft's loading doors and the methods selected for furnishing food and other passenger supplies; fuel; engine injection water and miscellaneous fluids; electric current; pneumatic power; air conditioning; disposal of sewage and other wastes; and such other services as may be required.

3. The power plants have several critical characteristics: exhaust blast temperatures and velocities, which vary with power output (Fig. 1); noxious fumes that are products of combustion of JP-4 or kerosene fuel; and high-intensity noise peculiar to the operation of turbo engines. This noise, caused by the exhaust blast and compressor whine, is proportional to power output. An FAA report states that "the sound intensity generated by a large turbo-jet aircraft on the apron 100 ft away, may reach 140 decibels in the frequency range of 128 to 2048 cps." The tolerable intensity is of the order of 80 or 90 decibles.

4. The wheel base, tread, wing span, length, and location of the aircraft's turning point establishes the pavement space and wing-tip clearances required in maneuvering it (Fig. 1), while the weight of this 300,000-lb vehicle requires very high applications of power to start movement and to negotiate sharp turns.

The considerable ability of modern transport aircraft to land and take off under high cross-wind conditions has led to the practice of providing a dominant runway system, supplemented by a secondary system in some locations where unusually high winds variable in direction are prevalent. A wind-rose made from meteorological data is used as a guide in determining local wind patterns. At terminals where high peak-hour acceptance rates are anticipated, dual parallel runways are used as the dominant system.

To attain the most efficient design for this system, it is necessary to carefully consider the jet-airliner's ground handling characteristics, as well as the costs of maintenance and operation which, for example, have been estimated to be of the order of $15 per minute for ground movement.

The master planner's reasoning in solving this problem will be clear to engineers and aviation executives but frequently it will be found that the city commissioners and tax-paying "sidewalk superintendents" are still thinking in terms of the all-direction airports of the "boots and goggles" or "DC-3" days. And since many millions in public funds may be involved, it often becomes necessary to go into very elementary discussions.

Consider a hypothetical master plan developed for a new Jet Age transport air terminal at a major traffic hub, where the anticipated peak-hour acceptance rates will exceed 50 landings (the maximum safe rate for one runway) and the "turn-around time" will vary from 30 minutes to well over one hour. The general layout on which such a plan is based might well take the form shown in Fig. 2.

Basic "staggered parallel" pattern

Education of the city commissioners or other authorities immediately concerned, and the general public, may require step-by-step discussions of this layout, such as the following.

In determining the optimum location for aircraft parking space with relation to the runway used for landing (Fig. 3), it is obvious that Position

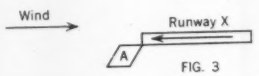


FIG. 3

A is ideal since the aircraft rolls into it after landing with the minimum amount of brake action and application of power. Position B in Fig. 4 is

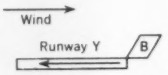


FIG. 4

the ideal parking position for aircraft using the takeoff runway, since the minimum taxi distance is required.

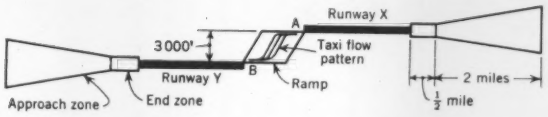


FIG. 5. Basic configuration of a staggered parallel dominant runway system.

Combining these two arrangements results in the "staggered parallel" dominant runway system shown in Fig. 5. When the wind direction reverses, Y becomes the landing runway and X the takeoff runway.

Safety considerations require separation of parallel runways used simultaneously for landings and takeoffs, to avoid possible collision between aircraft that may have missed their approach and aircraft taking off. Present opinion considers 3,000 ft to be the minimum safe distance between the runways.

Provision of end zones and approach zones follows conventional safety practices. The dimensions of the ramp are determined by the total square yardage required to provide the desired number and size of parking positions and interior taxiways. The particular merit of this arrangement is obvious. Aircraft move smoothly from the point of touchdown through the assigned parking spaces to the takeoff points.

The maximum acceptance rate of a runway is in part proportional to its occupancy time, since safety considerations will not permit a landing aircraft to enter the final phase of its approach until the runway is clear of other aircraft.

Modern aircraft being capable of negotiating long-radius, small-angle turns on the ground at speeds of 45 to 60 mph, it is our thought to provide "rollout" lanes rather than taxiways (Fig. 2), which will permit the landing aircraft to evacuate the runway in the shortest time possible and coast to the ramp area with the minimum application of brakes or power. Three lanes diverging from the runway at angles of less than 30 deg, and with turning radii of 2,000 ft, should satisfy the performance characteristics of the several categories of aircraft under varying conditions.

The most important element in the master plan is the design of the ramp area, loading positions and interior taxiways. It is at this point that the planner runs head on into the radical changes in airport design philosophies generated by jet airliners and Jet Age peak-hour runway acceptance rates. Detailed study of the ground handling problems connected with the operation of the large jet airliners is essential in arriving at design criteria for this component of the airport. When out of their natural element, the air, jet airliners become great unwieldy ground vehicles weighing well over a quarter of a million pounds, propelled by engines ill suited to start and maneuver them at slow ground speeds. They cannot be whipped around like two-place piston-powered trainers or the DC-3, negotiating intricate and devious taxi patterns involving short-radius turns and the dodging of opposing traffic.

These considerations have led us to believe that an "open-ramp" configuration, as shown in Fig. 2, will be the most efficient. This provides a smooth flow of unopposed traffic from entrance to exit of the ramp area with only five turns of 60 deg each. This should be compared with some of today's airports using finger-pier loading positions where it is not unusual to make one 360-deg turn and six or eight 90-deg turns between the touchdown point and the take-off position.

At a major terminal a subway system under the ramp area will be needed to connect with the necessary above-ground structures at each loading position on the open ramp so that passengers, supplies and cargo can be moved safely and expeditiously to and from jet aircraft.

When the volume of peak-hour traffic exceeds the acceptance rate of an existing airport it is necessary to add runways or build another airport 16 or more miles distant (a finding in the "Curtis Report"). The result is a high cost and loss in over-all operating efficiency. Our concept of "staggered parallel" runways, as shown in Fig. 5, provides for such expansion, as shown in Fig. 2. Each basic runway is augmented by a companion runway.

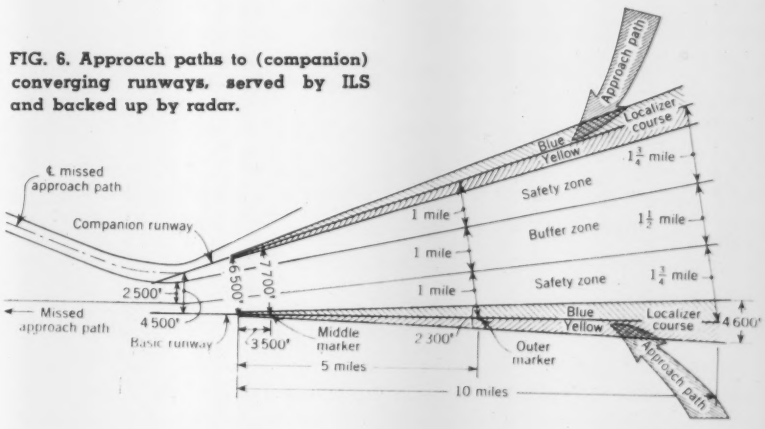
One pair of runways is used for simultaneous landings while the other is used for simultaneous take-offs, thus doubling the acceptance rate of the basic design. If ILS (Instrument Landing System) is used and backed up by radar it is believed that air traffic control requirements for separation of aircraft under IFR (Instrument Flight Rules) conditions will be adequately met, as shown in Fig. 6.

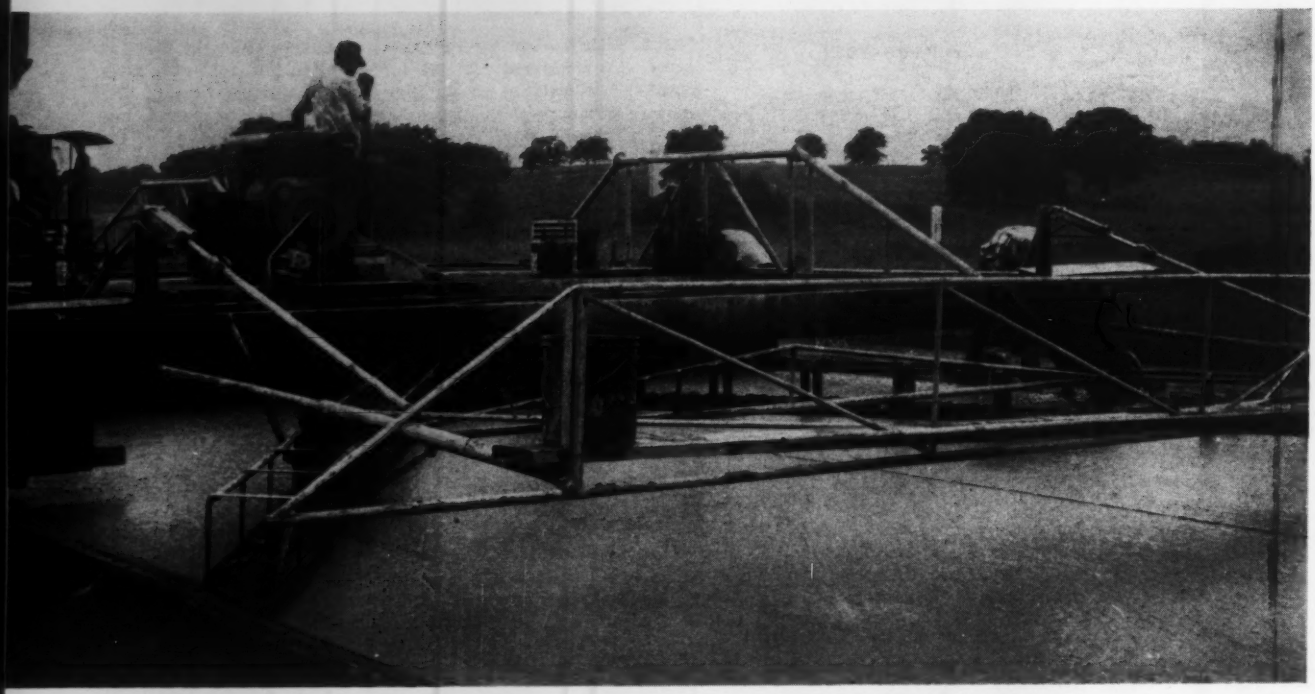
The companion runway configuration, or a modification of it, can also be used to provide a secondary runway system where crosswind conditions require it.

It is evident that the Jet Age encompasses a great deal more than just the first generation of subsonic jet airliners and the present-day volume of air-carrier traffic. In developing criteria for guidance in preparing master plans for civil airports, the engineer must consider the predicted growth in air transportation and all types of aircraft employed, including the supersonic airliners already on the drawing boards and the advanced types of turbo-prop aircraft now coming into use in the commercial aviation fleets.

This discussion has been oriented toward the requirements of a really large airport. However, the same basic concepts will be found valid for smaller installations with such modifications of the ramp and loading positions as may best suit the local situation. For example, the forecast might indicate that the field would be used mainly by small piston and turbo-prop, plus a small percentage of jet airliners. In this case a combination of open-ramp positions for the jet airliners and finger piers for the others might suffice. Under almost any circumstances it will be found that the basic configuration of the "staggered parallel" dominant runways will be by far the most efficient and economical as far as aircraft operating costs are concerned.

FIG. 6. Approach paths to (companion) converging runways, served by ILS and backed up by radar.





Long-wheel-base finishing machine; the chevron-shaped float shown operates independently of the side forms.

CONCRETE PAVEMENT FOR JET AIRCRAFT

GORDON K. RAY

Manager, Highways and Municipal Bureau

Portland Cement Association, Chicago, Ill.

Innovations in methods of construction are making runway concrete better, smoother and more durable to meet jet aircraft requirements. Uniformly compacted subgrades, double-duty forms, joints of higher quality, automatic batching and great trains of placing equipment permit economic pavement construction. Better machines for producing, checking and correcting the surface provide a concrete pavement that meets the challenge of today's air transport.

There has been a very great change in design and construction since the first concrete runways were built in 1928-1929. Then, the uniform 6-in. thickness or the 8-6-6-8-in. thickened-

edge slabs, borrowed from roadway design, were quite adequate. And such slabs continued to carry planes that grew to the 15,000-lb wheel load of the twin-engine DC-3 and even the 20,000 to 25,000-lb single-wheel load of B-17 and B-24 bombers.

Near the end of World War II, the B-29 Superfortress introduced a new problem in pavement design—a dual wheel load of 60,000 lb. When the four-engine DC-6's and Constellations were introduced at civil airports, the 6-in.-thick pavements were found inadequate. Since that time, airport design and construction has been a race between the aircraft designers—who are attempting to carry more passengers and more cargo for longer distances—and the airport pavement engineers—who are trying to build their pavements strong enough to carry the constantly increasing aircraft loads.

As gross aircraft weights have increased, additional tires have been added to landing gears to distribute the load over a wider area. This has permitted tremendous increases in aircraft weights without proportional increases in pavement thicknesses. But the 296,000 lb of the Boeing 707 and the 287,000 lb of the Douglas DC-8 transports do require heavier pavements than the DC-3. And the 500,000-lb B-52 requires pavements three to four times as thick as does the B-17.

The demand for thicker pavements, longer runways and an accelerated construction program at both civil and military airports is being met economically by greater mechanization of equipment developed by contractors, engineers and manufacturers. Many specialized machines, materials and techniques of concrete pavement construction have grown out of military air-base construction. Nearly all these developments have carried over to civil airport construction and many are now being used by highway contractors to produce more economical roads.

Better pavement starts with more attention to subgrade and subbase preparation. Requirements for more uniform compaction of both fine-grained and granular materials have resulted in the development of better compaction equipment. Vibratory-type rollers and plate compactors have brought about more economical densification and produced stronger pavement foundations. The use of super compactors for proof rolling of subgrades and subbases has permitted contractors and engineers to locate unstable material and correct it prior to paving.

As pavement thicknesses have increased, the size of paving forms has also increased—to a point where truck-mounted cranes are generally used for loading and unloading forms and placing them in approximate position. Form pins are driven and pulled by new machines specially devised for this purpose. Frequently an airfield has pavement of different thicknesses—one for runway ends, taxiways and aprons, another for runway interiors. The paving forms are made so that the sides and bases are of different heights and interchangeable, to serve two thicknesses. This arrangement reduces the number of forms a contractor must have on hand.

Thick pavements, commonly placed in lanes 25 ft wide, require a huge volume of material for an economical and timely finishing operation. Automatic, or at least semi-automatic, batching is provided for accurate control of materials through portable plants. Conveyors fed by cranes may be used to charge the batchers, where, a few years ago, one crane handled all materials. Most plants provide automatic weighing of a number of batches containing as many as four different materials. Usually these plants operate with a minimum of manpower and make continual records of batch weights for each ingredient, to assure better construction records.

A huge train of equipment is used for placing concrete and finishing the surface of a runway. It is not uncommon to see four or five 34-E dual-drum pavers on an airport construction job, with batch trucks and water trucks servicing the pavers, followed by spreaders, deep vibrators and finishers.

To assist the contractor in attaining the close surface tolerances required for smooth-riding pavements, equipment manufacturers have developed a number of new finishing machines with a long wheelbase. These combine the operations of the standard finishing machine with the mechanical longitudinal float in one operation. Most of these new machines are constructed in such a way that the final floating operation is supported from the frame of the long-wheelbase machine so that it operates independently of the side forms. This minimizes the effects of any deviations from the true grade in the setting of the form. In addition to building a smoother pavement, the elimination of one machine from the paving train results in greater economy and efficiency.

The advent of jets has required better joint construction and better joint-sealing materials. Jet blasts of high temperature and velocity soften conventional joint-sealing materials and blow them from the joint. Jet engines suck up loose particles from the pavement surface, creating a serious mechanical hazard.

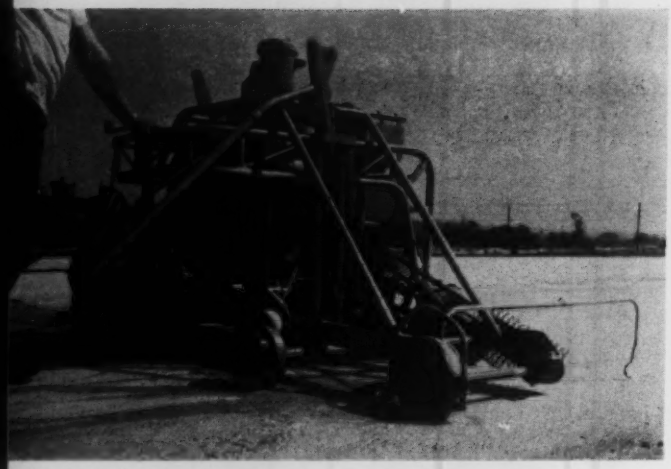
These troubles have been alleviated by eliminating expansion joints generally and using full-depth joints only when paving is stopped at the end of a day. For crack control, a sawed transverse joint one-sixth of the thickness of the pavement, or the depth of the maximum-size aggregate, whichever is greater, is frequently used at a spacing of about 25 ft. In areas where the coarse aggregates are so hard that sawing is expensive or difficult, preformed mastic strips are now placed in grooves vibrated in the plastic concrete. To permit joint sealing, these are removed by sawing after the concrete has hardened and cured. If the strips are placed behind the final mechanical finishing and ahead of the straightedging operations, they provide positive crack control at the contraction joints and permit sawing at a later time than is possible with the ordinary sawed joint. Hot-poured rubber asphalt or cold-placed rubber mastic makes a joint filler that will withstand jet blasts and fuel spillage.

The advent of jet aircraft, with their higher landing and takeoff speeds, their new configurations and smaller control surfaces, has brought about new and stricter requirements for smoother riding pavements. Today's high-performance aircraft will not tolerate the ruts, bumps and uneven surface characteristics that could be negotiated by lighter, slower planes. Tolerance specifications have been tightened to permit a maximum deviation from a 12-ft straightedge of only ⅛ in. in the longitudinal direction. On U. S. Air Force runways any pavement that is more than 0.04 ft from the established grade must be removed. Such limitations soon will be applied to commercial fields.

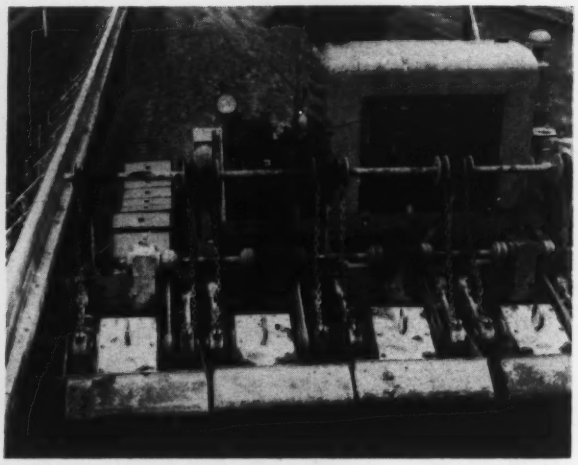
The testing of hardened concrete surfaces to make certain that they comply with the tolerance limitations has resulted in the development of better and more accurate testing straightedges. The old, hand-operated straightedge is giving way to the rolling straightedge. These make a permanent record of surface deviations or indicate to the operator any variations in excess of the specified tolerance so that he can mark the location of such spots on the pavement. These rolling straightedges are available in 10, 12, or 16-ft lengths to meet the job specifications. Military agencies are now asking for a straightedge that checks all of a 12-ft width at one pass.

If inspectors diligently check the surface with some type of testing straightedge on the morning following paving, and if they insist that any deviations be corrected at that time by the contractor, smoother pavements will be obtained and, in turn, better aircraft performance.

Correction of surface irregularities has always presented a problem to paving engineers. The development of bet-



Concrete saw, using diamond or abrasive blade, cuts contraction joints in the hardened concrete.



Vibratory compacter used for densification of granular subbase materials on an airfield.

ter bump cutters in recent years has permitted inspectors to insist on the correction of surfaces that do not comply with specifications. One such bump cutter employs a 12-ft wheelbase and a cutting edge 16 in. wide, made up of diamond saw blades. (See CIVIL ENGINEERING, April 1959, p. 50.) The cutting head on this machine can be set to automatically remove irregularities that exceed the specified tolerance.

Curing of concrete now is most frequently done by spraying on a white-pigmented compound. This retains the moisture in the concrete and reflects rather than absorbs the heat of the sun. The specifications of the Corps of Engineers, U. S. Army, require curing with wet burlap for 24 hours, then permit substitution of the compound.

With the demand for all-weather flying has come a growing use of de-icing agents for both pavement and aircraft. Since these materials subject pavements to a greater number of cycles of freezing and thawing, airport engineers have increased their use of air-entrained concrete on all fields, both civil and military, throughout the country. Concrete pavements containing proper amounts of entrained air have proved durable under extreme conditions of freezing and thawing caused by spillage of aircraft de-icing solutions. Where pavements are completed late in the fall and the use of de-icing agents in anticipated at an early pavement age, a surface treatment of sprayed-on linseed oil is recommended, to protect the concrete until it has completely cured and dried.

With these innovations the concrete paving industry today is geared to handle a rapidly accelerating program. It is capable of building airfield runways, taxiways and aprons as rapidly as they can be financed and engineered by the sponsoring agencies. Design engineers should specify the maximum in durability, strength, pavement life and smoothness needed to permit aircraft operators to get the best possible performance out of their expensive aircraft. Maintenance costs and operational interruptions due to maintenance will be charges against the airport operator and the aircraft operator. They should insist that the pavement be designed and built to give every possible insurance against undue maintenance problems.

Boeing 707, first U.S. commercial jet passenger plane, is taxiing on a concrete apron. Note hangar door tracks in foreground.

Federal participation in airport development—the role of FAA

E. R. QUESADA, Administrator, Federal Aviation Agency, Washington, D. C.

Just as aviation is a vital part of the American economy, so the airport—or landing facility—is a public necessity.

The airport system of our country represents a substantial capital asset and a significant element in the nation's rapidly expanding economy. Those who shoulder the responsibility for planning ahead in any community must plan for adequate development of airports, for they vitally affect the local economy.

Many communities have discovered that an industry looking for a location site will consider carefully the airport and all available aviation facilities. These are often viewed in the same light as electric power, water, schools and other basic resources.

Prior to the organization of the Federal Aviation Agency (FAA), the former Civil Aeronautics Administration made an exhaustive study of the requirements of the national airport system to determine which communities need airport development. It found that there is an urgent need for runways, taxiways, ramp facilities and related structures to accommodate increasing aviation activities in the nation, especially with the advent of civil jet operations. The study stressed the need for new traffic control facilities and land acquisition to provide approach areas free from obstruction.

Many of these important and urgently needed projects are spread over the nation at 72 airports which, by the end of 1961, will serve about 500 jet aircraft to be operated by the nation's air carriers. Several airports are now being readied for civil jet operations and others must follow soon to provide expanded public service with these modern aircraft. This civil jet air traffic, of course, is in addition to the military jet operations that might be necessary in a time of military emergency.

The FAA is aware of these critical needs and supports the early construction and development of airports and related facilities. This Agency does not advocate the expenditure of federal funds for "back-of-the-ramp" structures such as terminal buildings, entrance roads and parking areas. Federal aid should be concentrated on airport facilities directly needed for safe and efficient flight operations. Furthermore, it is recognized that the maintenance and operation of our civil airports has, traditionally, been primarily a matter of local and state responsibility. This indeed is as it should be.

The role of the Federal Government in airport development, through FAA as its official instrument, is one of aid and assistance in areas of greatest need, technical and economic, and within the framework of the safety standards for which FAA is responsible.

Aviation has come of age and airports are becoming more and more financially self-sufficient. This trend toward economic stability and financial self-sufficiency is expected to continue. The FAA will certainly encourage and promote it, in line with the basic philosophy that the Federal Aid Airport Program should be limited to those projects which lie "in front of the gate," and which are essential to an adequate national aviation facilities system.

Grants-in-aid by the FAA, if amendments to the Federal Airport Act are passed by the Congress, will be made to assist in the construction of runways, taxiways, aircraft ramps, control-tower structures and installations for the proper lighting of such facilities. Non-aeronautical facilities at the airport will not be eligible.

The 1959 National Airport Plan, a document prepared annually, has just been released. This National Airport Plan, the first to be developed under the FAA, relates to the public airport needs of all segments of civil aviation in the fifty states, Puerto Rico, and the Virgin Islands for the calendar years 1959-1962. It encompasses concepts not heretofore applied.

It is much more comprehensive than earlier plans and expresses future needs in greater detail, consistent with the best available scientific and technical data. This has been done in the belief that the Congress and the public are entitled to have FAA's professional and objective appraisal of the nation's overall airport needs, apart from any question of the financial ability of local agencies to construct such facilities.

The purpose of the National Airport Plan is to specify in terms of general location and type of development the projects considered necessary to provide a system of public airports adequate to anticipate and meet the needs of civil aviation. Accordingly, the statement of need included in this plan should not be related to the need for federal participation under the Federal Airport Act. Inclusion of an airport in the plan does not necessarily indicate ability, intent, or commitment on the part of the local community to proceed with development, nor should it be construed as a commitment of the Federal Government to participate financially in such a development.

Direct correlation of the plan with the requirement for federal aid is not possible because the initiative for the execution of individual projects rests in all cases with the local authorities. This plan establishes requirements only, recognizing that many of the communities may be unable to raise the necessary funds for construction, or unwilling to go ahead for other reasons.

Over the long haul, those areas that do not plan for aviation services will find themselves bypassed by new enterprises. Let's make no mistake, the benefits of air travel and air cargo transport are many, and the growth of entire geographical areas will be directly related to their aviation development. Just as our great industrial and cultural centers have developed near harbors, waterways, railroads and great highway arteries, future development will parallel airport facilities serving sizeable areas. The Air Age, Space Age, or Aerospace Age—take your choice—is not in the future; it is now!

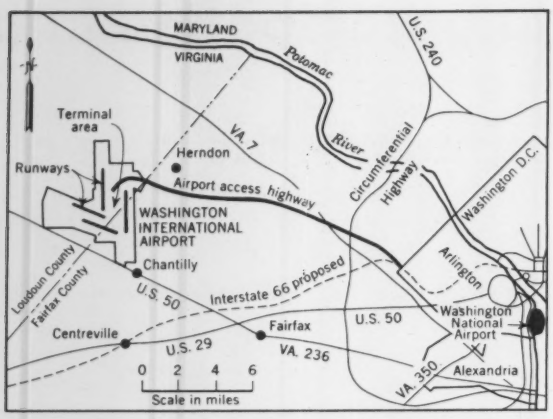


FIG. 1. Site for Washington International Airport is 27 miles west of Washington, D. C. Layout for airport area includes two north-south runways and two west northwest—east southeast runways.

Washington International Airport—

HERBERT H. HOWELL, M. ASCE, Director, Washington Airport Project,

It is anticipated that in less than twenty years the number of airline passengers arriving at or leaving Washington, D. C., will increase from 12,000 to 41,000 daily. In the year 1975 about 15,000,000 are expected. To help meet these anticipated demands, the Washington International Airport, now under construction at Chantilly, Va., is being built so that its facilities can be readily expanded, enlarged or supplemented as the need arises.

The provision of adequate airport facilities for the Nation's Capital has been a concern of the Federal Aviation Agency and its predecessor agencies since planning for the existing Washington National Airport was begun in the mid 1930's. The great expansion in civil aviation that followed World War II taxed the capacity of this airport. It had served Washington well, and would continue to do so, but evidently could not meet future needs. After much study, it was concluded that the solution lay in the development of an additional airport.

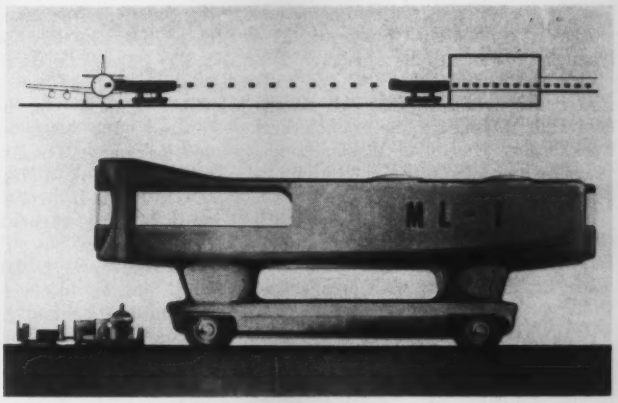
In 1950, Congress passed enabling legislation for such an airport and made an initial appropriation for the acquisition of land, although the site had not yet been determined. In 1951, a site near Burke, Va., was selected and a part of the necessary land acquired. The controversy occasioned by the selection of this site was a factor in preventing any action toward a second airport until 1957. In August of that year, the Congress made an appropriation for the initial development of an airport with the condition that no funds were to be expended until a special Presidential study was made for the selection of a site.

A study of all available sites, made under the direction of Elwood R. Quesada, then Special Assistant to the President, resulted in the choice of a site 27 miles west of Washington, near Chantilly, Va. See Fig. 1. Since selection of this site was announced, on January 14, 1958, rapid progress has been made in the planning and construction of the airport, with completion scheduled for early 1961. No specific boundaries were set, nor was any single layout recommended. Rather, a general area approximately five miles by six miles was studied, which was capable of accommodating a variety of airport runway layouts.

Studies were undertaken immediately to ascertain the best layout for the area. The layout that was chosen consists of parallel north-south runways, 11,500 ft long, and 6,700 ft apart, overlapping 50 percent of their length. Initially a single east-west runway was provided but subsequent studies of wind conditions dictated a shift to west northwest—east southeast. It was determined that the westerly winds would occur with sufficient frequency to warrant the provision of parallel runways in this direction. The final plan therefore provides for parallel west northwest—east southeast runways, 10,000 ft in length and 3,000 ft apart. These runways also overlap by approximately 50 percent of their length.

The terminal area will be located between the parallel north-south runways

Diesel-electric earthmover levels large areas for runways, taxiways, and terminal. Huge R. G. Le Tourneau unit has power on all wheels and is self loading.



A "mobile lounge" will be used to move passengers from terminal to plane at the Washington International Airport. Long loading fingers and long walks for passengers will thus be avoided.

a model for the Jet Age

Federal Aviation Agency, Washington, D. C.

where they overlap. A feature of the runway layout is that, with 60 percent of the operations expected to be from south to north, the easterly runway will normally be used for landings and the westerly runway for takeoffs. High capacity is afforded, however, by placing the easterly end of the northernmost west northwest—east southeast runway in close proximity to the takeoff end of the westerly north-south runway. This permits aircraft to take off simultaneously on both of these runways since the takeoff paths diverge.

On the basis of this runway layout, the airport property lines were established. The criteria used to determine the boundaries were: (*a*) a distance of 2,000 feet laterally from the centerline of any runway, and (*b*) 8,000 ft longitudinally from the end of each runway. The final configuration is shown in Fig. 1. Initially, it was planned to acquire 2,700 ft of property beyond the end of each runway, taking easements for control of the ground surface for an additional mile. When it was found that the cost of such easements would approximate the cost of full ownership, title was acquired for the full distance of 8,000 ft.

The site consists of approximately 9,600 acres of land in Fairfax and Loudoun Counties in Virginia. The area is primarily agricultural and thinly populated. Growth is anticipated in the areas around the airport, however, just as it has occurred around all major airports in this country. It is believed that no more land will ever be required for the airfield. The large amount of land acquired gives assurance to surrounding communities that they can develop with the minimum amount of interference from the airport. Likewise, the airport is assured that community development will not interfere with airport operations since the airport area is sufficient to provide for a 150-ft clearance at any point on the boundary.

The land acquisition program was started late in January 1958, when the Department of Justice filed the initial condemnation action in Federal Court. Virtually all the property is now in federal ownership, although negotiations with some of the former owners are still going on. As a part of the land acquisition proceedings there was a considerable amount of utility relocation. Fifteen miles of local roads within the area are to be closed, and agreement has been reached on the provision of replacement roads.

When the selection of the site was announced, the U. S. Coast and Geodetic Survey began the necessary aerial and site surveys to produce planimetric and topographic maps. These maps, when completed, served as the basis for detailed engineering studies. The Weather Bureau set up automatic wind recording instruments to obtain wind information on the site; the Bureau of Public Roads began its studies on the most feasible means of access; and a geological study was undertaken by the U. S. Geological Survey.

Simultaneously with the initial layout studies, proposals from architects and engineers were received and evalu-

ated. Ammann & Whitney of New York was selected as the consulting engineers, associated with Burns and McDonnell of Kansas City, Mo., for the utility and mechanical work, and with Eero Saarinen and Associates of Bloomfield Hills, Mich., for the architectural work. Ellery Husted of Washington is associated with Ammann & Whitney in master planning. Landrum and Brown, airport consultants from Cincinnati, Ohio, are doing the economic studies and forecasts. The consultants have made rapid progress with engineering and architectural studies.

Actual construction was started on September 2, 1958, when clearing and grubbing began. The site was about 15 percent timbered, and more than three hundred structures were removed or demolished. None of the standing timber is being removed from a belt extending 1,000 ft inward from the airport boundaries. It is planned to reforest this entire area with a variety of timber species so that, in a relatively few years, a timber belt 1,000 ft wide will entirely surround the airport. This will be of marked value in screening adjacent areas from ground noise.

Heavy grading was started on October 27, 1958. To date, three contracts have been awarded, which involve clearing and grubbing, grading and drainage, and paving of runways and taxiways. Approximately 11.5 million cu yd of earth excavation is involved, together with the installation of more than 75,000 lin ft of storm sewer.

The pavement contract involves the placing of some 1,650,000 sq yd, of which 1,200,000 is portland cement concrete, and 450,000 sq yd, bituminous pavement. The layout of the pavement work now under construction is seen in Fig. 2. It involves the two north-south runways, 11,500 ft in length, and the northerly west northwest—east southeast runway, 10,000 ft in length. Each runway has a parallel taxiway, and initially holding pads will be provided at two locations. The runways are 150 ft wide, with 25-ft shoulders. The taxiways are 75 ft wide, with 25-ft shoulders.

The portland-cement concrete runways and taxiways are designed for a 100,000-lb single wheel load, based on a 200-psi footprint pressure. This is adequate for an aircraft with an anticipated gross weight of 500,000 lb on a landing gear similar to that used on current jet transport aircraft. This results in a pavement 15 in. thick on 9 in. of crushed-aggregate base course in critical areas, and a 12-in. pavement thickness of 9 in. of base course in non-critical areas.

Runway and taxiway shoulders consist of 2 in. of asphaltic concrete, on 4.5 in. of crushed aggregate base. These shoulders are of light construction, but will be adequate to support snow-plow trucks and sweepers. It is planned to sweep or vacuum clean the runways at frequent intervals to prevent the ingestion of debris by jet aircraft engines.

Each of the three runways will be provided with high-speed exits or taxiway turnoffs. This is believed to be the first airport to use the results of the recent studies made by the University of California for the former Airways Modernization Board, now the Bureau of Research and Development of the Federal Aviation Agency. A detail of the turnoffs is shown in Fig. 2. Because the runways have parallel taxiways adjacent to them, wide-radius turns have been provided for at the intersections of the high-speed turnoff taxiways and the parallel taxiways. This will permit fast turns onto the parallel taxiways—if desirable or if necessary because of inadequate deceleration of aircraft. The turnoffs are designed for a maximum runway exit speed of 60 miles per hour.

The paving contract provides for the installation of more than 3,000 bases for future lighting. This includes bases for high-intensity runway edge lights, runway centerline lights, taxiway edge lights, and center-line lights up the throat of each high-speed taxiway turnoff. Bases will be installed for narrow-gage lights at each end of each runway. These flush-type, high-intensity lights consist of bars of lights extending 3,000 ft inboard from the runway end, with the bars separated to mark a throat 60 ft wide along the centerline of the runway. They are considered to be of vital assistance to pilots in contacting the runway under the most severe periods of restricted visibility. Thus, for a nominal investment now, any future pavement cutting and jacking of ducts under the pavement—both very expensive—will be minimized or eliminated.

Initially, light fixtures will not be installed in all the narrow-gage installations, but only on the approach ends of runways equipped with instrument landing systems. Two such systems are scheduled for initial installation. It is significant, however, that full provision is being made to install landing aids for

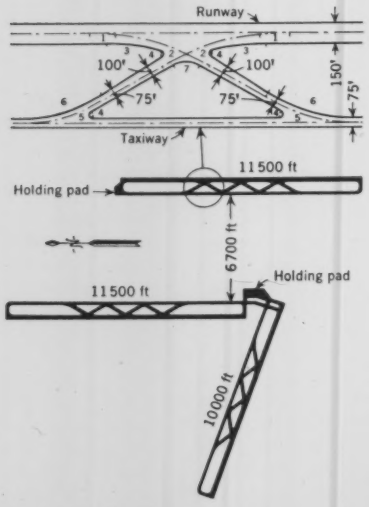


FIG. 2. Now under construction are the two north-south runways and the northernmost west northwest—east southeast runway. Detail shows typical two-direction high-speed runway exit, in which small figures indicate approximate radii, in feet, as follows: (1) 3,138, (2) 1,846, (3) 1,568 (4) 25, (5) 1,438, (6) 1,400, (7) 200.

Euclid twin power unit gets an assist from a Michigan bulldozer in a speed-up. Normally the big unit loads itself.

each approach to each runway should this ever become feasible and desirable. At very little cost, the grading plans provide areas adequate to accommodate the future installation of instrument landing systems for bidirectional approach to each runway. This same long-range concept is being followed throughout in planning the airport.

The terminal area is not yet firmly designed, but all facilities for which plans have been prepared to date will accommodate almost any possible solution. The architects and engineers are evaluating all known methods of handling aircraft, passengers and the public, and discussing them with the carriers scheduled to use the airport. No final design will be undertaken until there is general accord on the methods to be employed for terminal-area operations.

Provision of adequate utilities has presented no small problem. Electric power service will be available. Water, however, must be brought from a considerable distance; it will be supplied by the Fairfax County Water Authority.

A large natural-gas main, traversing one corner of the site, will supply fuel to the central heating plant. No final solution has been found for the disposal of sewage wastes. Possible solutions range from an airport-based treatment plant to a long interceptor to transport the sewage to the District of Columbia's sewer mains and thence to its Blue Plains treatment plant. A treatment plant at the airport would release effluent either into the Potomac River, upstream from the District of Columbia water intake, or into Occoquan Creek, upstream from the Alexandria Water Company's storage dam. Neither is wholly compatible with area policies for watershed protection.

Apron facilities, not yet finally designed, will incorporate provision for utilities at ramp parking areas. An underground aircraft fuel system is planned to serve each gate position. Although there will be fuel storage facilities at the airport, no decision has been made as to how the fuel is to be transported to the airport. Various methods are being studied.

As a part of the project, a high-speed access highway is being developed to connect the airport with planned highways for rapid access to downtown Washington. Before the route for this access highway was selected, the possibility of bringing future state and federal highways nearer to the airport was studied. When this did not prove feasible, it was decided to construct an access highway as a part of the airport project. A great deal of planning and working with local communities went into the location of this highway. Four tentative routes were discussed at a public hearing.

The 17.8-mile access route finally selected (Fig. 1) connects the airport with the circumferential highway surrounding Washington, D. C., now under construction. The access highway continues on to a junction with the proposed Interstate Route 66, which will enter Washington over the new Constitution Avenue Bridge.

The access highway is planned initially as a four-lane divided route, with limited access, but with a right-of-way of sufficient width to permit an ultimate dual-dual arrangement. The State of Virginia has estimated that the average vehicular traffic generated solely by the airport will be 44,000 vehicles per day in 1975. In addition, it is necessary to plan for a high volume of traffic generated by areas to be developed between the airport and Washington.

No hangars will be constructed as part of the initial airport development. Adequate provision, however, is being made for them in the master plan. It is anticipated that they will be developed either by those who need hangar facilities, or with federal funds on the basis of self-amortizing leases, entered into by prospective tenants. It is contemplated that many associated facilities such as food service, kitchens, motel or hotel, and filling station, will be developed under this same alternate pattern. The site is large enough to provide ample area for facilities of all types.

Development of the new Washington International Airport will in no way minimize the importance of the existing Washington National Airport. The latter will continue to serve a substantial segment of Washington's air traffic. No definite determinations have as yet been made as to the division of traffic between the two airports. Its is logical to assume that, initially, the longer-range flights will be operated from Washington International Airport. With the Washington National Airport continuing to operate at peak capacity, virtually all the increased demand will have to be accommodated at Washington International Airport.

Present FAA forecasts indicate that the number of passengers at Washington National Airport will increase from the 4,500,000 actually arriving and departing in the fiscal year 1958 to an annual level of 6,000,000 passengers (between the present and 1965), which has been determined to be its optimum passenger capacity. It is likewise contemplated that the number of passengers using Washington International Airport will reach a total of 4,000,000 in 1965, 6,600,000 in 1970 and nearly 9,000,000 in 1975. With this forecast in mind, all facilities at the airport are being designed so that they can be readily expanded, enlarged or supplemented. The contract with the consultants provides that, in addition to plans for initial construction, working drawings and specifications will be provided for facilities required in the ultimate development of the airport. By developing these plans for the ultimate airport, with provision for frequent reappraisal, the airport can be expanded whenever or wherever needed.

Community planning has been a paramount objective in the consideration of each facet of the airport. Constant liaison has been maintained with all local, county, and regional planning agencies affected by the airport. The objective is to ensure that the airport will be a good neighbor and that both it and the adjacent areas will develop in complete harmony.

Compaction and proof rolling of subgrade is done by 50-ton Ferguson units at left, following sheepsfoot rollers.

Asphalt-paved San Francisco airport is one of the busiest civilian air facilities.

Pavement for heavy planes

PHILLIP A. HAHN, Chief, Washington International Airport Division, Federal Aviation Agency, Washington, D. C.

Pavement must be carefully planned and constructed to resist the touchdown loads of the heavy turbine-powered planes now being put into commercial service. Transport planes have increased in weight from 25,000 lb in 1937 to 300,000 lb at present. In prospect is a weight of 350,000 lb for later models of the current type of plane. Simple charts, shown here, give a quick means for determining the asphaltic or rigid pavement thickness required for varying subgrade conditions.

As aircraft have become heavier the load on the pavement has been distributed over a larger footprint area by multiple-wheel assemblies. The total load per main strut or wheel assembly still is considered as one-half of 90 percent of the gross load of the plane, with 10 percent taken by the nose wheel. For the larger wheel assemblies of turbine-powered aircraft, a prime problem is to determine how each strut weight is distributed through its multiple-wheel assembly. Consideration must be given to tire sizes, tire contact pressure and the geometry of the assembly. The most practical method is to relate the loads imposed by the wheels to a load in terms of one wheel, which will have the same effect on the pavement as the group of wheels. This relationship is called "equivalent single wheel load."

Interrelations of loading effects by single- and multiple-wheel gears have been determined by means of theoretical analysis, laboratory investigations, accelerated traffic tests on prototype pavements, and investigations of pavement performance. From these investigations it has been determined that the basic design concepts relative to soil and subgrade classification, as shown in Table I, and pavement thickness for single wheel loadings, as propounded by the FAA "Airport Paving" manual, are applicable to designs of "equivalent single wheel loadings."

Wheel loads for flexible pavements

For flexible pavements, a relationship has been established between the spacing of wheels in a multiwheeled undercarriage and the depth of action and interaction of the forces induced in the pavement by the load transmitted by the wheels. See Fig. 1. Two depths-of-load reaction are critical controlled factors in the conversion to equivalent single wheel loads. They are: (*a*) the depth to which each wheel of the undercarriage assembly acts independently as

Concrete paving proceeds on Chicago's O'Hare Field. Photo, Consumers Co., Chicago.

TABLE I. Airport paving subgrade classification

FAA Soil Group	Good Drainage		Poor Drainage	
	No frost	Severe frost	No frost	Severe frost
E-1	Fa or Ra	Fa or Ra	Fa or Ra	Fa or Ra
E-2	Fa or Ra	Fa or Ra	F1 or Ra	F2 or Ra
E-3	F1 or Ra	F1 or Ra	F2 or Ra	F2 or Ra
E-4	F1 or Ra	F1 or Ra	F2 or Rb	F3 or Rb
E-5	F1 or Ra	F2 or Rb	F3 or Rb	F4 or Rb
E-6	F2 or Rb	F3 or Rb	F4 or Rb	F5 or Rc
E-7	F3 or Rb	F4 or Rb	F5 or Rb	F6 or Rc
E-8	F4 or Rb	F5 or Rc	F6 or Rc	F7 or Rd
E-9	F5 or Rc	F6 or Rc	F7 or Rc	F8 or Rd
E-10	F5 or Rc	F6 or Rc	F7 or Rc	F8 or Rd
E-11	F6 or Rd	F7 or Rd	F8 or Rd	F9 or Re
E-12	F7 or Rd	F8 or Re	F9 or Re	F10 or Re
E-13	Not suitable for subgrade			

Runway Criteria

For turbine-powered aircraft

Air Carrier Service	Runway Length, ft	Runway Width, ft	Pavement Loading, lb
Local	4,200	100	30,000
Trunk	6,000	150	60,000
Continental	7,500	150	75,000
Intercontinental	10,500	150	100,000

The runway lengths associated with each airport type are established for standard temperature (plus 41 deg F), sea-level elevation, and zero slope gradient. Length corrections are made to compensate for the effect of altitude and runway gradient. The pavement loading is shown as "equivalent single wheel loading," as explained in text.

a single wheel, bearing its proportionate weight of the total gear load, and (*b*) the depth below which the loads on all wheels of the assembly interact so that the combined effect is the same as if the entire assembly load were being imposed by a single wheel.

Investigations have shown it to be substantially correct to presume that wheel-load stresses are transmitted through the pavement in cones having 45-deg. slopes. On this basis, for dual wheels, the first depth of importance, for individual wheels, is equal to one-half the clear distance between the contact areas of the tires. The second depth, (*b*) above, for the assembly, is equal to twice the center-to-center spacing of the tires. With respect to dual-tandem undercarriages, the two depths are fixed by the clear distance between the contact areas of a pair of dual wheels and the diagonal distance between the centers of opposite fore and aft wheels.

At depth (*a*) the equivalent single wheel load is equal to the load of one wheel of the assembly. At depth (*b*) the equivalent single wheel load is the total load imposed by the assembly or the load on the strut.

In terms of the above, the relationship between the load on the assembly and equivalent single wheel load is a factor by which the gear load can be divided to simplify conversion to the equivalent single wheel load. Therefore it is evident that the conversion factor may vary from a high of the number of wheels in the assembly to a low of 1. In the case of dual wheel assemblies, the range would be from 2 to 1. For dual-tandem assemblies, the range would be from 4 to 1. Between the two limiting depths, the equivalent single wheel load varies as an exponential function of the depth of interaction of forces in the pavement. A straight-line plot on a log-log graph will show the variation between the two extreme conditions.

Plots representing the equivalent single wheel loads of aircraft are shown in Fig. 1 as lines A, B, and C. The end points of these plots are fixed by coordinates which are: (1) the load on one tire and half the clear distance between the contact areas of a pair of tires, and (2) the total load on the assembly and twice the distance between a pair of tires in the case of dual wheels, or twice the diagonal distance between tires for dual tandems.

Since the Federal Aviation Agency design method for flexible pavement utilizes a log-log graph of the various foundation conditions plotted to show pavement-thickness requirements for various single wheel loads, the equivalent single wheel load plot for any dual or dual-tandem gear arrangement can be plotted as explained above on this standard graph. The specific design requirements can be determined by the intercept of the subgrade curve with the equivalent single wheel load line as shown in Fig. 1.

For example, referring to Fig. 1, aircraft C is equipped with dual wheels spaced 30 in. center to center, with a gear load of 74,000 lb. The clear distance between tire contact areas is 16.4 in. This aircraft would require 17 in. of flexible pavement on a FAA class F2 foundation. The 17-in. pavement would also be satisfactory for 300,000-lb aircraft B, which has a 135,200-lb. strut load on dual-tandem gear having dimensions of 30 in. center to center of dual wheels, and a gear axle spacing or gear wheel base of 55 in. The intercept of both equivalent single wheel plots or gear-load configuration lines corresponds to an equivalent single wheel load of about 48,000 lb. Imposed on

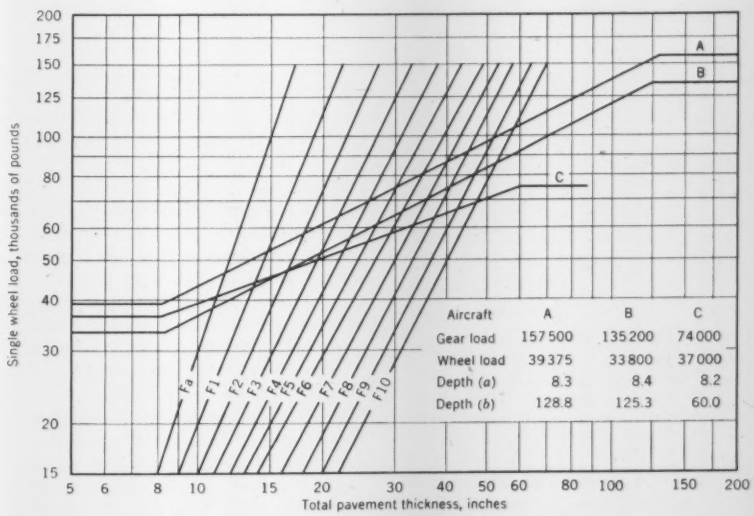


FIG. 1. Chart for flexible pavements determines "equivalent single wheel load" and pavement thickness for taxiways, aprons, and runway ends. For subgrade classifications (Fa, Fl, etc.) see Table I.

this pavement, the conversion factors for aircraft B and C would be 135,200 ÷ 48,000 and 74,000 ÷ 48,000 or 2.8 and 1.54 respectively.

It will be noted that the conversion factor changes considerably with subgrade condition. A study of a number of aircraft with varying numbers of wheels and different undercarriage geometry revealed a range of conversion factors from 1.1 to 3.6 for different classes of subgrade soils. Reasonable average conversion factors for existing dual and dual-tandem equipped aircraft can be established for each subgrade class. These factors are particularly useful in evaluating existing flexible pavements.

Wheel loads for rigid pavements

The procedure for determining "equivalent single wheel loads" on rigid pavements is based primarily on the formulas developed by Dr. H. M. Westergaard. The basis for the analysis consists of a determination of the magnitude of a single load which, when placed centrally on a concrete slab, will produce the same stress as that produced by two or four loads representing the loading of dual and dual-tandem undercarriages. The adoption of the center loading condition is considered valid for aircraft pavements since aircraft rarely travel near the outside edge of the pavement and all interior joints are provided with adequate means of load transference.

Several variables are involved in these calculations with respect to both the arrangement of wheels in the undercarriages and the pavement itself. Landing-gear variables include gear load, spacing of wheels and tire pressure. Pavement variables are the thickness of the concrete slab, the modulus of elasticity and Poisson's ratio for the concrete and the modulus of subgrade reaction. The familiar Westergaard radius of relative stiffness, l, was chosen as a basis for setting out the results of the calculations since it combines all the pavement variables.

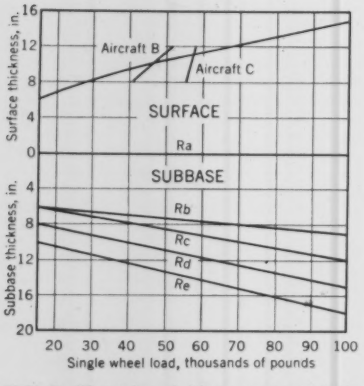


FIG. 2. Chart for rigid pavements indicates subbase and surface thickness for taxiways, aprons and runway ends. For subbase classifications (Ra, Rb, etc.) see Table I.

Families of curves have been developed for obtaining the conversion factor (divisor) to convert from either dual or dual-tandem gear loadings to equivalent single wheel loads. The computations required for entering the curves involve the spacing of dual tires, the spacing of the axles in dual-tandem gear, the total contact area of the tires (determined from loads and tire pressures), and the radius of relative stiffness. The conversion factors vary from one to two for dual gear and from one to four for dual-tandem gear, depending on these variables.

In the FAA design procedure for a specific gear arrangement, conversion factors can be determined for various pavement thicknesses and then the equivalent single wheel loads will be calculated from the total gear load. The single wheel loads for the various concrete thicknesses can then be plotted on the rigid pavement design curves, Fig. 2. The pavement required to satisfy FAA criteria can be determined by the intercept with the standard curve.

As shown in Fig. 2, the rigid pavement required for aircraft B is 10½ in. This is for the dual-tandem gear load of 135,000 lb for which the conversion factor is 2.83 and the equivalent single wheel load is 48,000 lb. Aircraft C requires 11½ in. of pavement for the 74,000-lb dual gear load. The conversion factor for aircraft C is 1.28 and its equivalent single wheel load is 58,000 lb.

The study of conversion factors for rigid pavements showed a relatively small variation by comparison with those for flexible pavements. Based on associated pavement thicknesses for the aircraft studied, a conversion factor of 1.35 for all aircraft equipped with dual wheel landing gear and a factor of 3.0 for all aircraft equipped with dual-tandem landing gear have been designated for design and evaluation purposes for rigid pavements.

Curve A of Fig. 1 represents the flexible pavement design requirements for an aircraft of 350,000-lb gross weight supported on dual-tandem gear. For this aircraft, the gear load is 157,500 lb. The equivalent single wheel load varies from 46,000 lb on an Fa subgrade to 110,000 lb on an F10 subgrade with required flexible pavement thicknesses varying between 12 and 60 in.

For rigid pavement, using the conversion factor of 3.0 for dual-tandem undercarriages, the equivalent single wheel load is 52,500 lb, and from Fig. 2 the required rigid pavement thickness is 11 in.

For the probable 350,000-lb aircraft, certain assumptions were made. They include: (1) the dimensions of the undercarriage are identical to those of one of the larger jets now proposed, and may be considered representative of this type of aircraft; and (2) the tire contact pressure is 150 psi.

Shoulder treatment

The outboard engine pods of a large turbojet aircraft moving along the center line of a 75-ft-wide taxiway will extend about 10 ft beyond the edges of the 75-ft width of full bearing strength.

Since these aircraft will not always be operated along the actual taxiway center line, shoulder areas adjacent to the taxiway should be treated for a lateral distance of 25 ft to prevent ingestion of foreign objects into turbines and prevent creation of objectionable dust conditions and blast erosion. The surfaced area along taxiing routes thus will be 125 ft wide. Holding aprons will also require treatment of shoulder areas 25 ft beyond any edge.

Operationally, it is expected that once a turbine jet-type aircraft is cleared for takeoff, it will proceed without interruption through a system of taxiways to the runway to takeoff position. An extended period of engine runup on the runway is not anticipated for civil jet aircraft. Thus surfaced blast pads at runway ends will not normally be required. If a practice did develop where a runup would occur at the end of a runway, then an area the width of the runway for a distance outward of 100 ft from the runway end might require surface treatment.

The treatment of shoulders to reduce the possibility of harmful ingestion of dirt into jet engines, and to support an occasional aircraft, need not provide a section of full design strength. Prevailing climatic influences should be considered in the design so that the shoulders will provide a surface free of loose particles and requiring minimum maintenance. The designer should recognize that the shoulders probably will be subjected to the traffic of plows, sweepers, and other maintenance and service equipment.

Shoulder treatment consisting of a 1½-in. bituminous concrete surface course placed on a base at least 4 in. thick, should satisfy these requirements. The base may be sand clay, caliche, aggregate or non-plastic select granular gravel. The bituminous concrete surfacing should never be placed on the natural soil unless such soil has properties at least equal to those suitable for a subbase material.

HELIPORT FRAMING

halved by ASCE-developed criteria

This report of the Air Center Committee of the ASCE Air Transport Division was prepared by its Chairman, W. C. Borland, M. ASCE, Construction Engineering Coordinator, Port of New York Authority, New York, N.Y.

Cost of roof-top heliports can be greatly reduced by revised design criteria without sacrificing any degree of safety for either occupants or aircraft. The structural framing for supported platforms, to be used by some helicopters in the 60,000-lb class, can be cut to one-half that currently required by the Federal Aviation Agency.

This is the conclusion of the Air Center Committee of the Air Transport Division of the American Society of Civil Engineers. The Committee is developing criteria of interest to civil engineers for the operation of helicopters, VTOL (vertical take-off and landing) and STOL (short-distance, about 200-ft, take-off and landing).

The first step in developing the structural requirements for an elevated landing platform for helicopters is to promulgate the general assumptions on which the design is to be based. Much of the controversy today on this subject is due to variations in these assumptions. The basic assumptions promulgated by the Committee are:

1. The platform should be designed to afford a reasonable amount of protection to the occupants of the aircraft.
2. Major repairs to the platform are to be anticipated in the event of a serious crash. However, the damage is to be limited to the platform. Supporting members of the platform and the structure below the platform are to remain intact.
3. The major elements of the aircraft are intact at impact of the helicopter on the platform.
4. The fuel available for combustion is limited to the full capacity of the tanks of the helicopter.
5. Adequate fire fighting equipment is available to handle crash and rescue work.
6. The allowable design stress of the structural steel is 85 percent of the ultimate strength of the material.

If these criteria are followed, the elevated landing platform will not be a bomb-proof shelter capable of sustaining the impact of a free-falling 60-000-lb body or a 6,000-lb engine dropped from a height of several hundred feet. However, the platform is required to absorb the impact of an emergency landing; it will be bent but will remain functional.

As the impact loading of the platform will, in all probability, be for an aircraft with its major components intact, limited to the force required to crumple the landing gear, let us review the practice of the aviation industry in developing the design of helicopter landing gear. The committee has been informed that in evaluating the strength of any component of a helicopter against the allowable stresses in aircraft material, the design load is compared with the ultimate or failing strength of the material.

The design load for aircraft is defined as 1.5 times the limit load; the limit load is the maximum load that is expected to be applied to any component during normal operation. Structural design practice for aircraft requires that any aircraft member be able to take its limit load without suffering a permanent set or without yielding, and to withstand the design load without failure.

About 2.5 times the gear load is usually taken as the limit-load factor for landing-gear design. Theoretically any stress in excess of 1.5 times the limit-load factor will cause failure of the gear. The unit loading of the platform necessary to fail the gear would be that part of the weight of the helicopter normally supported by the gear times 2.5 times 1.5. These forces would react over the footprint area of the tires required to support the load for any given tire pressure.

Assuming a 60,000-lb helicopter, supported equally at four points, the normal weight on each gear would be 15,000 lb. With a tire pressure of 100 psi, the footprint area would be 150 sq in. The theoretical design force necessary to crumple the gear acting on the footprint area would be 15,000 x 2.5 x 1.5 or 56,300 lb.

At the instant of surface contact, the helicopter's airfoil surfaces and rotor blades are developing lift, and the impact loading is roughly equal to the gross weight of the helicopter at rest. To develop sufficient resistance to crumple the gear of a helicopter, with its major components intact, it is necessary for the impact to be taken by one gear.

CAA design criteria place the unit loading on the platform at three quarters of the gross weight of the helicopter on one gear. Allowable stress in the steel is determined by the local building code. The stress in the platform for the CAA design criteria for a 60,-000-lb helicopter would be ¾ x 60,000, or 45,000 lb.

To determine the difference between the two design methods, assume that an elevated platform for a helicopter of 60,000-lb gross weight is to be designed using A-7 carbon steel. This has an ultimate strength of 60,000 psi, a yield strength of 33,000 psi, and an allowable working stress, by the New York City code, of 20,000 psi. For a helicopter of the same weight, with the same footprint area of the gear, most factors are constant for both designs. The difference in the section modulus of the steel is therefore proportional to the design loading divided by the allowable stress in the steel. For the CAA design loading, this factor would be $\frac{45,000}{20,000}$ or 2.25, and for the suggested method, the factor would be $\frac{56,300}{51,000}$ or 1.1. Therefore, the required section modulus for the CAA criteria is twice that for the suggested method.

The recommended design criteria are not as critical as they sound. The loading is instantaneous and is relieved almost immediately. The inertia of the mass of the platform structure has a cushioning effect upon supporting beams; the greatest stresses on the platform are the punching or shear stresses in the area of impact. As the design criteria provide adequate fire fighting equipment, fireproofing of the structural steel is not required.

Other aspects of helicopter operation of interest to the civil engineer will be prepared for publication as rapidly as the Air Center Committee of the ASCE Air Transport Division can review and assemble the information. In addition to Mr. Borland as chairman, the committee consists of Robert S. Angstadt, Herbert Howell, Howard G. Law, Joseph Mashman, Col. David B. Parker, Joseph Stuart III, Donald B. Talmage, and Donald M. Thompson.

Tar concrete resurfacing for a jet airfield

CHARLES J. CARTER

Airport Engineer

Wheeling-Ohio County Airport, Wheeling, W. Va.

ILS runway was resurfaced by a Barber-Greene paver, which placed a hot-lay tar-concrete overlay 1½ in. thick. Initial compaction was performed with a 10-ton, three-wheel Galion Roll-O-Matic, operating close behind the paver. Final compaction was obtained with a Galion tandem 12-ton steel-wheel roller.

Mix plant is located 20 miles from the job site, at Mingo Junction, Ohio. This two-ton Barber-Greene Batchomatic plant of Tri-State Asphalt Corporation is near the aggregate stockpiles of Standard Slag Company.

Tack coat of tar, grade RT-9, is being applied to old bituminous pavement at rate of 0.15 gal per sq yd. Note numerous patches where original pavement had been repaired.

Resurfacing of intersection and cross runways was given special attention. Mix was laid up to the edge of the cross runway. On the cross runway it was laid parallel to the cross runway centerline, then feathered out in the direction of traffic to meet the existing surface grade. This procedure brought about a smooth plane ride over the new paving, with no jolts.

Seal coat of tar and slag chips is rolled with steel-wheel roller, broom-dragged, then rerolled with Bros wobble-wheel rubber-tired roller, which is adjustable up to 15 tons.

Among recent preparations made for jet aircraft operations at Stifel Field (Wheeling-Ohio County Airport) in Wheeling, W. Va., was a resurfacing job that involved some 11,000 tons of hot-lay tar concrete. Included in the project, constructed by the Tri-State Asphalt Corporation of Martins Ferry, Ohio, in September of 1958, were the instrument landing system (ILS) runway, two taxiways and a portion of a large parking apron. This job is the first major step in a planned program of improvement and expansion at the airport.

The original surfacing at the Wheeling-Ohio County Airport was placed in 1945. It was a single course of hot-lay asphaltic concrete 2½ in. thick. This mix was laid over a stone base 10 in. thick, which had been constructed over a 9-in.-thick subbase composed of a mixture of bank-run gravel, sand and loam. Considerable difficulty was encountered with this surfacing, beginning a few months after the job was completed. Inadvertently, certain types of coal-mine shale and slate had become intermixed with the aggregates used to produce the surface-coarse mix. The presence of these improper or "reactive" particles in the aggregates used for the paving mixture caused many "boils" to develop as the "foreign" particles began a chemical reaction which broke and popped up the paving surface, especially after wet weather.

Each of these spots—averaging about one per square yard—required the removal of the offending particles followed by a small patching operation. Over the years the maintenance forces at the Wheeling-Ohio County Airport placed about 80,000 small patches, using tar (from drums) and fine aggregates. In fact, before this resurfacing project began, a cursory inspection of any of the runways or taxiways gave the impression of a "scabbed" surface. This was caused by the innumerable small patches, almost side by side, where boils had developed and had been removed and patched.

For this recent resurfacing job the Civil Aeronautics Authority (CAA), now the Federal Aviation Agency (FAA), matched funds with the County. To start the resurfacing project, the old bituminous concrete surface was swept clean by power brooms and then tack-coated with tar grade RT-9, at the rate of 0.15 gal per sq yd. After 24 hours, a single-course hot-lay tar concrete, designed to conform to CAA Specifications (Item P-401) and the Corps of Engineers Specifications (CE 807.12, a maximum aggregate size of ¾ in.) was laid to a compacted minimum depth of 1½ in. After a few weeks under traffic to allow for curing, the surface was sealed with tar grade RT-10 and ⅜-in. slag chips and was again swept clean.

Before resurfacing operations were started in 1958, all areas to be covered were inspected for cracks and other defects and necessary small repairs were made by the maintenance crew. In addition, all drainage structures and lines were checked and put in efficient operating condition. Along the pavement edges, there were places where the sodded and grassed shoulders had overgrown the bituminous surface. This

TABLE I. Mix formula for one 4,000-lb batch of tar-concrete resurfacing

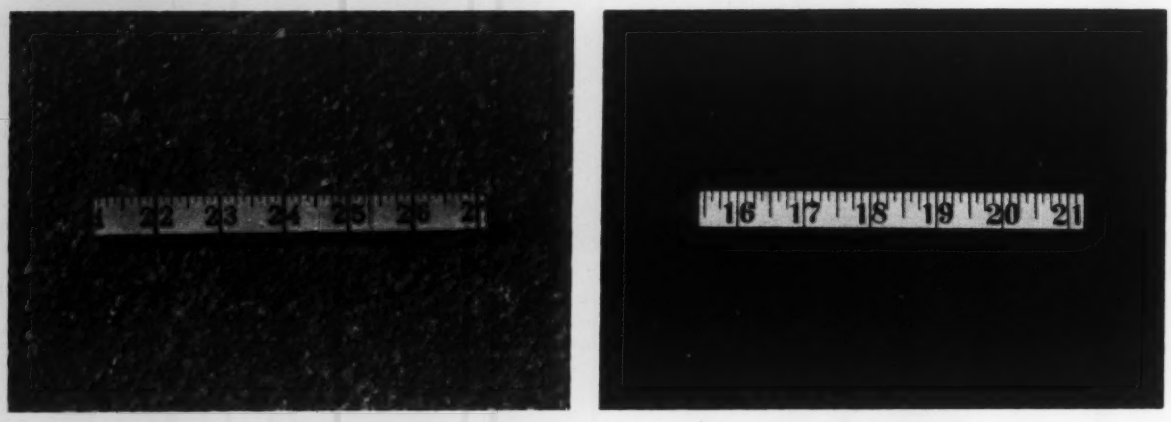
Bin	Sieve Size	Aggregate, %	Tar and Aggregate, %	Weight, lb
No. 3	¾ in.-⅜ in.	20	18.35	734
No. 2	⅜ in.-No. 8	30	27.50	1,100
No. 1	Passing No. 8	50	45.90	1,836
Tar, RT-12		..	8.25	330
		100%	100.00%	4,000 lb

TABLE II. Specifications and aggregate gradations for tar-concrete resurfacing at Wheeling-Ohio County Airport, 1958

Produced by Tri-State Asphalt Company, Mingo Junction, Ohio

Percent Passing	Calculated Mix Gradations: Slag-Plant Stockpiles	Calculated Mix Gradations: Mix-Plant Screened-Aggregate Bins	Mix Gradations from Mix-Plant Truck Samples	Specifications: CAA P-401 ¾-in. max.	Specifications: Corps of Engrs. CE 807.12 ¾-in. max.	Specifications: Tar Paving ¾-in. max.
¾ in. sq.	100	100	100	100	100	100
½ in.	88	85	85	82-100	85-100	85-100
⅜ in.	75	70	68	68-90	70-85	70-93
No. 4	56	53	53	50-79	50-66	50-80
No. 10	44	42	41	36-67	35-50	35-65
No. 40	18	17	17	17-44	15-25	15-35
No. 80	10	9	9	9-29	7-15	7-20
No. 200	5	3	4	3-8	4-10	4-10

After final compaction by the Galion steel-wheel roller, a fairly tight surface texture was obtained (left). After a month under traffic to allow for curing, the surface of the mix was sealed with tar, covered with slag chips, and rolled again (right).



growth was removed from the edges of the paved areas and the sod cut back to a straight line, to an elevation slightly below that intended for the finished resurfacing course.

The tar concrete resurfacing mix was produced by the Tri-State Asphalt Corporation in its plant at Mingo Junction, Ohio. This plant, a new two-ton Barber-Greene Batchomatic, had mixed only a few thousand tons before this job was started. Slag aggregates, ¾ in. to No. 4, and sand passing the No. 4 sieve, were obtained from the nearby Standard Slag Company's plant. These two aggregates were hauled in about equal proportions to the feeder bins of Tri-State's mix plant. They were heated to slightly in excess of 200 deg F, then screened into the three hot-aggregate storage bins—¾ in. to ⅜ in.; ⅜ in. to No. 8; and everything passing No. 8.

Mix formulas were set up by the Koppers Company's Road Materials personnel, based on analyses of Standard Slag Company stockpiles, and bin samples from the Barber-Greene mix plant. The approximate mix formula used is given in Table I.

As variations occurred in the incoming slag aggregates (from stockpiles), appropriate changes were made in the mix formula to maintain a uniform grading. The original mix formula was slightly revised three times, but the tar content remained constant. Listed in Table II are the mix gradations and the applicable CAA Specifications. Also listed are the calculated mix gradings, based on aggregate samples from stockpiles and screened aggregate storage bins, together with other specification grading limits covering tar concrete paving. Note that the mix was designed to fall within the more "open end" of the grading limits, since the job specification called for a seal of tar and chips.

Tar, grade RT-12, was hauled by Tri-State's tankers from Koppers' tar plant at Follansbee, W. Va. The tar at 225 deg F was added to the aggregate batch (200-210 deg F), and the mix (14-ton loads) hauled some 20 miles to the Wheeling-Ohio County Airport at Short Creek, W. Va.

At Stifel Field, the mix was dumped from the hauling trucks into a Barber-Greene paver, and laid in 10-ft widths parallel to the runway edge. Paving was started on one side of the runway and progressed by adjacent lanes toward the other side. The mix was first compacted by means of a 10-ton, three-wheel roller, operating fairly close to the paver. Final compaction was obtained with a tandem 12-ton steel-wheel roller. A fairly tight surface texture was obtained, with coarse slag particles showing. The resurfaced areas were opened to airport traffic within 24 hours after final compaction.

Paving was stopped only when airline schedules required that the ILS runway or a taxiway be cleared for plane traffic. This usually occurred twice daily—necessitating a short delay in paving operations each time. Special attention was paid to paving the intersections and cross runways. In those areas, the mix was laid parallel to the centerline of the runway being resurfaced and up to the edge of the cross runway. The paving on the cross runway was then laid parallel to the centerline of that runway and feathered out in the direction of traffic to meet the existing surface grade. This was done so that planes using the cross runway would not strike a bump when crossing the new paving.

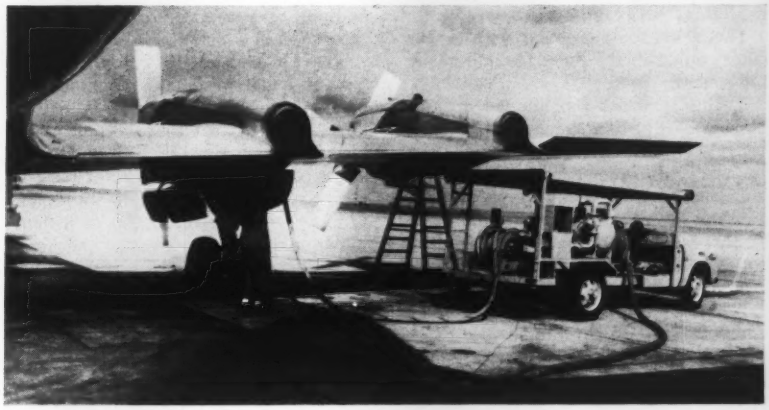
After a month under traffic to allow for curing, the contractor sealed the surface with tar, grade RT-10, applied at 250 deg F, using 0.3 gal per sq yd. This was covered by 11 lb per sq yd of ⅜-in. slag chips. The aggregate was rolled with a tandem steel-wheel roller, broom-dragged, then rolled with a rubber-tired roller. After 24 hours, all excess loose cover aggregate was removed and the completed job opened to traffic. A light-colored, close-textured abrasive surface was obtained with this sealing operation. All loose material is picked up by Spears-Wells towed-type airport sweepers with capacities of about 1 cu yd.

It is expected that this tar concrete resurfacing and seal will rejuvenate, reinforce, and restore the pavement to the condition required for many more years of useful service to the Wheeling area. When jet aircraft begin to use the Wheeling-Ohio County Airport, there will be no reason to worry about the effects of jet fuel spillage—on those areas resurfaced with tar concrete.

For Tri-State Asphalt Corporation, operations at Stifel Field were under the direction of Leo Handler. The mix plant superintendent was Herb Miller. Paving operations at the airport were supervised by the writer, who is deeply grateful for the valuable help and guidance given by John H. Coulson and Paul F. Phelan, AM. ASCE, of the Koppers Company of Pittsburgh, Pa.

AIRPORT FUELING SYSTEMS FOR JETS

Fuel is dispensed to a Lockheed jet-prop Electra from underground delivery system by a Garside hydrant cart. Photo courtesy of Allied Aviation Fueling.



JAMES P. O'DONNELL, M. ASCE, Consulting Engineer, New York, N. Y.

Along with the many advantages offered by jet transportation are various problems caused by the special treatment that the new aircraft require. Many airport storage and handling practices used in refueling piston-powered aircraft will be unsatisfactory for turbine-powered jet planes

At many airports the modernization of the fueling system for the pressured fueling of jets will include installation of underground fixed hydrant systems to replace some or all truck refuelers. Most of these systems will be installed to service jets but some will be used to fuel piston-powered aircraft, particularly in the period when jets are replacing props. These hydrant systems will use piping to connect airport fuel storage tanks with flush hydrant installations located at apron fueling positions. Problems generally familiar to the civil engineer are involved in the engineering of these systems.

There are several reasons responsible for the rather drastic changes needed to provide adequate fueling facilities for jets. Among them are the increased capacity of the planes, the characteristics of the fuel, and the economics of jet aircraft operations.

Jet-plane capacities

The greatly increased plane capacities, accommodating as many as 150 persons on a fully loaded plane, make safety a primary consideration, particularly if refueling is carried out at gate positions while passengers are deplaning or enplaning.

Because the fuel capacities of long-range jet aircraft are two to three times those of piston aircraft, that is, from 15,000 to 22,000 gal, (50 to 75 tons), two refueling trucks of conventional size cannot service a jet for an intercontinental or non-stop transcontinental flight. At least two extra large (8,000-gal) refuelers, or more than two conventional trucks, will be required.

The greater fuel loads required also directly affect the fueling rate per plane. To permit full loads to be taken on, when required, in the limited ground servicing time permitted, fueling rates for jet aircraft will be in the range of 1,000 to 1,200 gpm, compared to a maximum of about 400 gpm for the piston planes in current use. A 1,200-gpm plane fueling rate will correspond to a 600-gpm flow through the apron fueling hydrants, as present designs use two hydrant carts to service each jet plane.

Jet-fuel characteristics

Clearances are much less in jet-engine fuel systems, and flight altitudes will be generally higher than for piston-engine planes. This results in more stringent requirements for jet fuels compared to aviation gasoline in terms of cleanliness (freedom from rust and other solids) and dryness (to prevent freezing at the higher flight altitudes), as serious in-flight hazards can result from dirty fuel and from fuel-system icing. If fuel filters clog with ice, bypassing fuel can carry dirt to clog screens at bleed orifices in control circuits and at engine fuel nozzles.

Present jet fuels can be divided into two main types. The first, similar to military type JP-1, are fuels with kerosene characteristics. Those in the second, JP-4 group, have much wider boiling

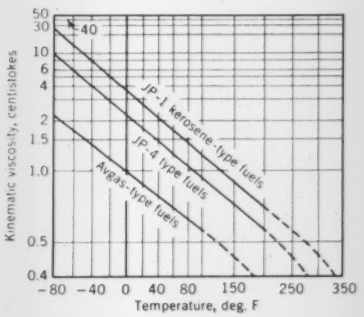


FIG. 1. Jet fuels have higher viscosities and densities than regular aviation gasolines.

ranges and can be considered as mixtures of natural gasoline and kerosene. Both types are in commercial use today. Because of certain basic physical properties, cleanliness and dryness are hard to maintain in jet-fuel storage and loading operations. Other properties introduce safety hazards not present in the same degree with aviation gasolines.

Higher viscosity (Fig. 1) and density of jet fuels result in retention of contaminants in suspension much longer than in aviation gasoline. For example, the settling rate of small suspended particles of dirt and water droplets in kerosent jet fuels is about one quarter the rate of similar settling in aviation gasoline.

Jet aircraft economics

The economics of jet passenger plane operations is such that maximum use of the aircraft in revenue-producing service is required. Unscheduled interruptions in service are more serious than in piston-powered aircraft. Therefore, strict control of the purity of jet fuel delivered to planes (with resulting longer life of engine filters and engine parts), more reliable functioning of engine fuel system controls, and reduced maintenance and engine-overhaul interruptions to flight schedules can add appreciably to airline earnings.

Fixed hydrant systems

The basic elements of a fixed hydrant fueling system (Figs. 2 and 3) are:

1. Airport bulk storage with a capacity equal to the fueling requirement for several days.
2. Bulk transfer pipelines to operating or satellite storage.
3. Satellite storage with a total capacity equal to the operating fueling requirements—usually one day's supply. Satellite storage may be eliminated if airport bulk storage can be located close to plane fueling positions.
4. Satellite transfer pipelines to underground apron distribution systems which feed fixed hydrants on the apron.
5. Hydrant carts which serve as fuel dispensers for hydrants to planes. These require connectors for "hooking-up" the ground hydrants to the carts and the carts to plane fueling inlets.

The design of these systems will include civil engineering problems common to hydraulic design, except that a flammable liquid must be handled instead of the more usual water. In view of this and the preceding discussion, the two most important design criteria for an airport system to fuel passenger jets can be established.

1. The system must be safe. Passengers, both on the airport and enplaned, and all operating personnel must be safeguarded.

The greatest safety hazard, in any system handling flammable liquids, is fire or explosion. As liquid fuel cannot burn until converted into vapor or fine mist in the presence of air (or oxygen) in proper proportion, the most positive safety approach from the fire standpoint is to prevent the formation of a flammable mixture of fuel vapor and air in all areas where its accidental ignition could endanger life or property.

Also important to safety in jet fueling operations is the safe disposal of liquid fuel, and resulting vapors, in case of accidental spills. The malfunction of a liquid-level-controlled shut-off valve in an individual fuel tank of a plane being fueled may dump liquid fuel through the plane's vent system. As a hydrant flowing 600 gpm is passing 10 gal of fuel under pressure each second, fast-acting controls are required to stop flow in emergencies. Because of equipment malfunction or misoperation, a large spill can be created rapidly as a result of these high fueling rates and the pressures used (up to 50 psig required at the fuel inlet on some planes). Minimum precautions should be "dead-man" control of fast-acting hydrant valves, remote control of fuel flow through emergency buttons at each gate to immediately depressure the system, as well as an adequate fire-fighting system to safeguard passengers and airport personnel in the event a fire should occur during fueling.

Provision for rapid removal of spilled fuel is also required, especially in the handling of JP-4 type fuels which have a low pool temperature—that is, the lowest temperature at which a flammable vapor and air mixture will exist above a pool of the liquid. The usual means of providing quick drainage by suitable slopes to sewer inlets or catch basins is of particular importance. The use of sealed inlets in the design of the apron drainage system should not be overlooked as a means of controlling vapors resulting from spilled liquid fuel and of preventing their contact with ignition sources. Flamable ranges of jet fuels are shown in Fig. 4.

2. Fuel quality must be controlled. This is an absolute necessity to ensure that there will be no engine malfunction in flight due to poor fuel quality. Monitoring systems, preferably with automatic cutoff of fuel flow to the aircraft when quality is unsatisfactory, appear to be the only positive method

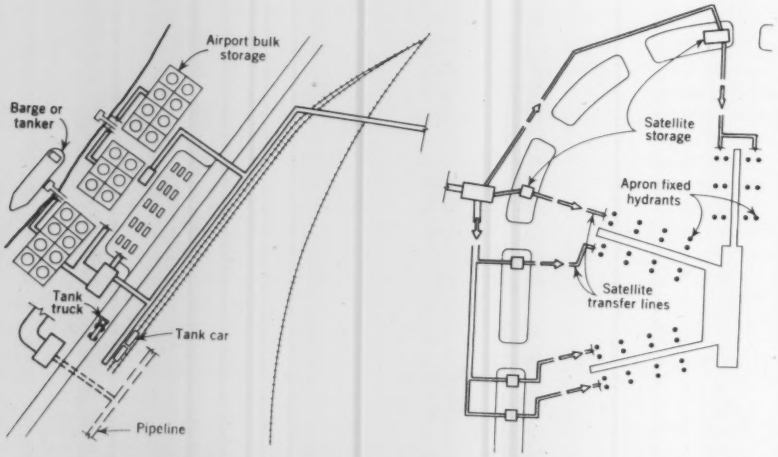


FIG. 2. Modernization of the fueling system at many airports will include the installation of an underground fixed hydrant system to replace some or all refueling trucks. Piping will connect airport fuel storage tanks with flush hyrant installations at apron fueling positions.

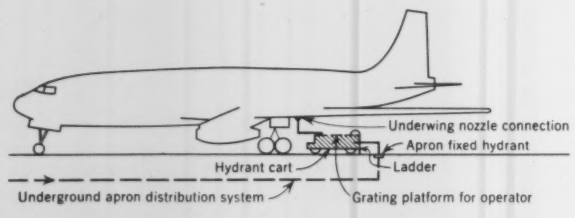


FIG. 3. Hydrant carts will serve as fuel dispensers to jet planes. Carts will be designed with connectors for hooking up to the airport ground hydrants and also to the plane fueling inlets. About twenty minutes is maximum allowable fueling time.

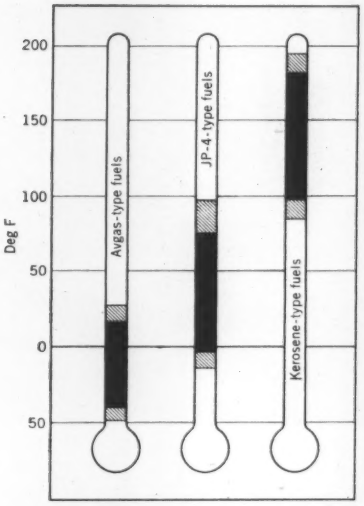


FIG. 4. Graphical representation shows approximate temperature ranges in which the fuel vapor space of vented storage tanks located at sea level will be within flammable range. (Intensity indicates frequency.)

to guarantee that fuel of required cleanliness and dryness is actually delivered to the plane tanks from the airport system.

Other design requirements of the system are:

3. Short fueling time. The delivery of a full fuel load to a plane must not extend its ground time; approximately twenty minutes is the maximum allowable fueling time.

4. Supply dependability. Each system must provide for airport servicing by an adequate number of fuel suppliers and must provide as many alternate supply methods as practicable.

5. System dependability. The system must be designed throughout to assure uninterrupted servicing of planes.

6. System economy. The system must permit the use of the most economical supplier transport and resulting bulk price, low airport handling costs, and consequent low fuel cost delivered in plane tanks.

7. Flexibility in system expansion. The system must permit economical alterations to satisfy future airline needs as to different fuels or quantities.

Fixed-hydrant fueling operations at an airport can be either on a consolidated basis or through separate systems each of which is a complete system in itself. Usually the airport management or airline groups operate consolidated systems, and individual airlines or fuel suppliers to the airport operate separate systems. Both operations are often carried on by service companies acting as agents for the system owners.

Costwise, a consolidated system permits economies by eliminating certain duplication of equipment at fuel unloading areas, bulk storage areas, and in pumping, filtering, piping and other equipment. More efficient and economical use of operating personnel is also possible with consolidation. Also there are usually fewer problems for airport management in such matters as arranging for space and rights-of-way for tankage and piping runs, when such arrangements can be made for a single consolidated system instead of for several individual systems. Under either type of operation, it is the practice in the United States to maintain brand identify for all fuel grades handled in the system.

Design problems

Problems generally familiar to the civil engineer are involved in the layout and design of civil airport fueling systems, and all these problems will not be discussed. Required in the systems are unloading facilities for bulk fuel (delivered by barges, tank cars, pipelines or tanker trucks), fuel storage tanks, fuel transfer and distribution piping, and equipment for filtration, dewatering, flow control, pressure control and metering. Two design problems that may require special consideration are:

1. Hydraulic surge. In systems with long supply lines to the hydrants, quick shutoff of fuel flow at high fueling rates in normal or emergency operations creates transient high pressures in the flowing system. These hydraulic surge effects may be controlled by such means as reducing flowing velocities through larger pipe diameters and by using surge suppressors. A positive control method is to use a "break-pressure point," which shortens the system length but requires repressuring after the break point.

Development and testing is now proceeding on a pressure-control valve with "anticipating" features to replace conventional hydrant valves. This valve would anticipate the closing of the plane's fuel-tank inlet valves and close before them, thus locking up a relatively low pressure downstream of the anticipating valve and protecting the plane and hydrant cart equipment from pressure surges. The shock pressures would thus be transferred to the airport's underground fueling system. Such anticipating valves will require foolproof features to positively prevent excessive surge pressures, normally retained upstream of the valve, from damaging a plane in the event of the valve's failure.

2. Static charges. Dependent on factors such as flowing velocities, lengths of pipelines, type of fuel used, and location and type of filtering and water separating equipment, precautions may be required against excessive accumulations of electrostatic charge in an airport fueling system. The American Petroleum Institute has recently started investigations of this problem at the Massachusetts Institute of Technology and at Johns Hopkins University.

Summary

In this brief review only the highlights of design principles and considerations involved in airport fueling system for jets have been mentioned. Development of equipment and application techniques in many other items such as the following is still in progress:

Improved micronic filtering and dewatering equipment which will assure the actual fuel purity required in aircraft fuel systems and engines in all flight environments, particularly at low temperatures. The establishment of the performance specifications for such equipment to assure this required fuel purity is a problem not yet resolved.

Continuous monitoring equipment to check fuel purity throughout the handling cycle of the airport system from fuel receipt to plane loading, especially at the latter point.

Inert gas pressuring techniques for fuel transfer from storage, thereby eliminating vapor hazards, product loss and air-borne contamination at storage.

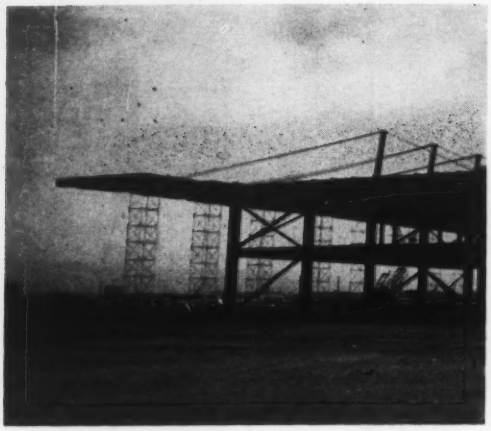
Improved design details, such as swing-joint or equivalent high-strength type connectors on hydrant carts, minimum vapor type seals for floating roof storage, submerged inlets and charge relaxation devices to reduce static electricity hazards, and floating suctions to reduce contaminant withdrawal from storage tanks.

Digital computers applied to system control, inventory, metering and billing; and analog techniques applied to quality control.

Mobile or fixed equipment to remove objectionable fuel vapors released from plane vents during fueling operations.

Suitable non-ferrous piping and equipment to reduce fuel contamination due to corrosion.

The selection of specific equipment and design techniques for individual airport systems will depend on features of safety, efficiency and economy thereby introduced. In evaluating such economies, it is important to consider the overall savings in aircraft operations which result when refueling is performed only from airport systems maintaining strict purity control of all fuel loaded into aircraft tanks.



PLANNING HANGARS

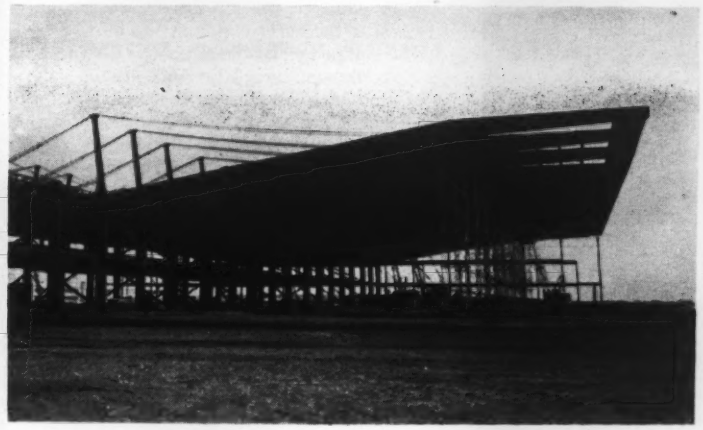
BOYD G. ANDERSON, M. ASCE,

Suspended trusses form a very simple, light, and efficient structural steel system for providing necessary large bay areas at a Lockheed Hangar at the New York International Airport.

Greater hangar space with rapid access and efficient arrangement for maintenance and overhaul is required for today's jet planes. Changes in this field of service are fully as important as the improvement of runways and terminal facilities. The wing span of today's jets is greater than the total distance flown by Orville Wright in the first flight of a propelled aircraft, less than sixty years ago.

The jet era, in addition to having a very substantial influence on air carrier operations and airfield and terminal systems, is imposing equally severe demands on the overhaul and maintenance plants of airlines. Economic survival of commercial air carriers is virtually contingent on efficient ground handling operations because of the large capital investment and operating costs for the new jet aircraft.

Many factors normally influence the location of hangars within the airport area and for today's jet aircraft some of these factors have added significance. Among these are the factors affecting the time the jet planes are on the ground, the wear on the planes and the fuel consumption involved in ground towing and taxiing of the huge planes. In addition to factors directly affecting the planes, the hangar location is also



This hangar at the New York International Airport is similar to the design shown in Fig. 1 except that a double cantilever span arrangement has been used.

FOR JET AIRCRAFT

Partner, Ammann & Whitney, Consulting Engineers, New York, N. Y.

influenced by the need for large auto parking areas and high-speed highway systems to accommodate the increased hangar personnel required by jet era traffic. An additional consideration involved in the location of hangars for jet planes is that of esthetics. Since the hangars, because of their size, tend to dwarf the other facilities, they must be placed so that they complement the other structures and do not overwhelm incoming passengers.

Each hangar and its associated facilities will occupy a plot of approximately 30 acres. The hangar bays in this area will be supplemented by office, shop, and storage facilities as well as by apron areas that are three or four times as large as the hangar bays. These areas provide room for engine runup, preservice storage and general storage before peak-schedule operations begin. The opposite end of the hangar site will have a service road leading from the main highway to employee parking lots and to receiving docks in the hangar.

A check list of facilities required in a typical jet hangar building appears in Table I with the space allocated to each. This list is based on a survey of hangars each approximately 500,000 sq ft in area. A division of the space within a specific jet-type maintenance hangar is shown in Fig. 1.

The main hangar bays will dominate the arrangement of the hangar unit and influence the cost, efficiency and flexibility of the total installation. These bays must be laid out to handle a combination of aircraft such that each plane can be moved without interference with others as services are initiated and completed. Inasmuch as the cost of many hangar installations exceeds 15 million dollars, the planning of the bays should prevent obsolescence due to minor changes in plane sizes. However, the $1,500,000 to $3,000,000 invested in each hangar plane position must be directed primarily toward ensuring quick and efficient maintenance for the specific size and type of aircraft expected in the current carrier fleet at the time of the planning.

The long spans needed to cover the high bay areas can be attained by the use of single or double spans cantilevering outward from a central core or by single or multiple bays supported at the sides and spanning in the direction of the wing chord. Either steel or concrete may be used to form each type. Two structural schemes that have been used to provide long cantilever spans are shown in Figs. 2 and 3.

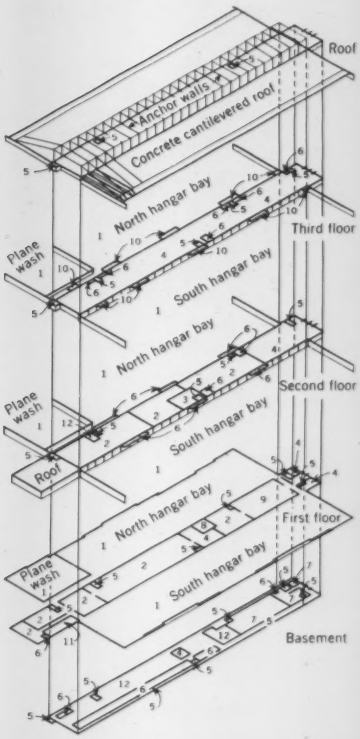


FIG. 1. In this typical jet-type maintenance hangar, nearly 50 percent of the total area of 500,000 sq ft is occupied by hangar bays. Hangars are designed so that mammoth new jets can be handled without interfering with other planes. Numbers indicate: (1) hangar bay, (2) shops, (3) stores, (4) offices, (5) traffic, (6) rest rooms, (7) food units, (8) medical, (9) mechanical, (10) electrical, (11) laundry, (12) miscellany.

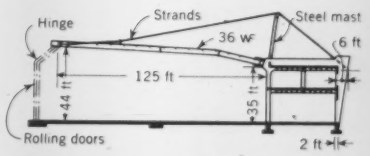


FIG. 2. Single cantilever span consists of precast channel slabs supported by structural steel purlins carried by a rolled girder. Girders are supported near the outer end by wire strands tied back over a steel mast to the concrete lean-to framing.

Two hangars utilizing a folded-plate roof of reinforced concrete were recently completed at New York International Airport.

The single cantilver span of Fig. 2 consists of precast channel slabs supported by structural steel purlins carried by a rolled-beam member. The girders are supported near the outer end by wire strands tied back over a steel mast to the concrete lean-to framing. The rolled-beam member is fixed at the lean-to frames to stiffen the roof under normal loads and to assist the weight of the roof in resisting the upward force and flutter effects of wind. A similar type of hangar for the New York International Airport, utilizing double cantilevers, is shown in a photograph.

Roof structures of reinforced concrete are also used to cantilever over jet hangar bays. The hangar shown in Fig. 3 utilizes a folded-plate roof of reinforced concrete supported near the outer end by wire strands. Two such hangars were recently completed by the Port of New York Authority at New York International Airport; these are shown in the accompanying photographs.

A more detailed description of these hangars, shown in plan arrangement in Fig. 1, may be useful in pointing out problems typical in the design of all hangars of the size and complexity required for jet aircraft. As is obvious from the space requirements given in Table I, the hangar bays form the bulk of the building space and this area is concentrated as close as possible to the shop areas. The shop areas in turn have ready access to material storage areas and to docks where materials and supplies are delivered.

The great hangar bays are covered by a thin skin of reinforced concrete cantilevered out as much as 150 ft from the center core. The thickness of the concrete skin ranges from 4½ to 6 in. and is stabilized by folding the skin into multiple corrugations 6 ft deep. Four-member wire strands, of 1½-in. diameter, pick up the roof reactions near the outer end, and the horizontal component of the strands is used as a prestressing force to provide a tight roof and eliminate most of the roof reinforcement that would otherwise be required between the cable connections and the center core. The moments developed by the anchorage for the strands in the center section are in turn used to help carry the long interior spans desired over the central core area.

The outside walls of the hangar bays must be movable to permit aircraft to enter at any point along the length of the building. This flexibility is provided by flat sliding doors rolling singly or in groups as desired. Since cantilevers of 150 to 160 ft are inherently flexible, the connection between the roof and upper door assembly must be designed to permit free motion. Such motion is provided by the use of vertical sliding pins at the upper roller, by pantograph-type guide framing or, in these hangars, by making the upper part of the door a hinged canopy. This canopy type of door also serves to reduce the length of the roof cantilever as well as to allow for the vertical motion of the cantilever roof.

It has been more or less standard practice to enclose the sides, doors, and roof of hangar bays with a blanket of insulation covered on the roof by conventional built-up roofing. However, in view of the heat lost by the air leakage when doors are moved and opened, the heat needed to warm cold planes entering the hangar, and the cost of insulated and membrane roof coverings, the hangars with folded-plate roofs at New York International Airport were provided with experimental coverings consisting solely of inexpensive paints, bitumens, and plastics.

Heavy concentrated wheel loads imposed on the hangar floor slab and apron required heavy-duty concrete pavement (13 in. thick) with the surface hardened for resistance to jet fuel and ease of maintenance. Either floor drains or slit trenches or both are designed to accommodate runoff from the deluge sprinkler systems.

Mechanical and electrical services are similar to those for any other large plant installation. Heat is supplied to all areas by hot water or steam. The plant is designed to maintain the office-shop areas at about 70 deg F and the hangar bay areas at 50 to 60 deg F. Either roof-mounted unit heaters or radiant heating or both are used in these areas. This is common practice for hangar-bay heating although direct-fired unit heaters have been used in some structures.

Interior areas, except the hangar

TABLE I. Facilities in a typical hangar building

Facility	%
Hangar area	46.5
Shops, overhaul & maintenance	12.0
Storerooms	9.0
Administrative offices	16.0
Traffic corridors	5.5
Rest rooms	3.0
Food units	2.5
Medical area	1.0
Mechanical rooms	2.5
Electrical rooms	1.0
Laundry	0.5
Miscellany	0.5
	100%

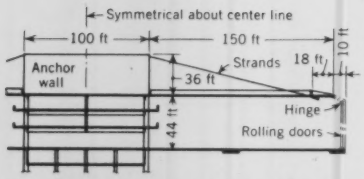


FIG. 3. Folded-plate roofs of reinforced concrete, supported near their outer ends by wire strands, constitute another means of providing the necessary space for jet hangar bays.

bays, are supplied with mechanical ventilation. Air is recirculated and changed according to conventional practice. Safety codes are followed and special precautions taken in such areas as paint spray rooms and flammable storage rooms. Air (cooled or warmed) is distributed through sheet-metal ducts to ceiling diffusers or louvered supply grilles. Summer air conditioning is used extensively in areas housing large numbers of personnel and where a controlled atmosphere is required for production such as in instrument shops.

Electrical power is supplied from two sources and automatic crossover equipment is provided. Auxiliary equipment furnishes emergency power. The voltage is converted at two load centers to 240 or 480-volt three-phase distribution systems. Current supplied throughout the hangar building areas is generally 110 volts but higher voltages and direct current are supplied as needed in special areas. Lighting design criteria are based on the average for industrial-type buildings. The lighting intensity varies from 50 ft-candles at desk height in office areas to less than 1 ft-candle in corridors and locker rooms. General lighting for the hangar bays is fluorescent, furnished by fixtures at ceiling level. Outlets are furnished for lighting local areas as needed.

Communication systems provided include telephone, teletype and public address. Often these buildings will also house all or part of the major communication systems of the airlines for the area. A closed-circuit fire-alarm system is connected into the airport proprietary system. A thermostatically operated rate-of-rise deluge system, with open sprinkler heads, is used in hangar bays. Other areas use automatic wet-pipe systems with fusible-link-type sprinkler heads and concealed piping.

Lightning protection is provided in accordance with standard practice. There are brass or bronze ball-type grounding receptacles at all aircraft positions.

Service islands within the hangar bay at each jet aircraft position provide compressed air, electrical power, communication, lubrication, and water. Serious study is being given to the feasibility of fueling aircraft from the same source.

The unit cost of the cantilever-type hangar has been increasing considerably with the increased spans needed to cover the new and larger aircraft. For this reason the vault-type hangar shown in Fig. 4 offers promise and should be considered in future hangar planning. With this type of construction a series of vaulted bays would be provided, each accommodating a single large plane. Since the individual vaults do not depend on balancing cantilever loads, the hangars can be one sided, with a more flexible and accessible arrangement of lean-to buildings for shop-storage-office uses.

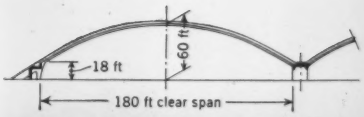
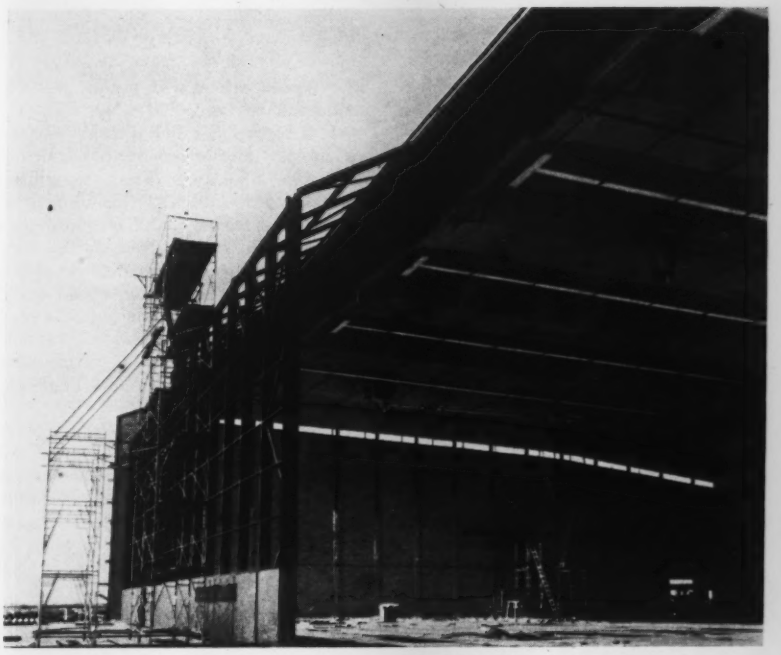


FIG. 4. Vault-type hangars are being considered by planners who envisage a row of vaulted bays, each bay to accommodate a single large plane.



Special doors were designed by Ammann and Whitney for the TWA hangar at New York International Airport. The doors, built by the Peelle Company, Brooklyn, New York, permit aircraft access at any point along the length of the building. Free motion between roof and upper door assembly is provided by use of a hinged canopy for the upper part of the door. This type of door also reduces the length of the roof cantilever. Note heating and sprinkler outlets in the roof.

The writer would like to express his appreciation to John M. Kyle, Jr., M. ASCE, Chief Engineer of The Port of New York Authority, for the photographs of the hangars constructed under his direction at the New York International Airport.

Control tower, New York International Airport.

Planning airport terminal buildings

THOMAS M. SULLIVAN, M. ASCE,

Deputy Director, Aviation Department,

The Port of New York Authority, New York, N. Y.

Each airport has unique passenger terminal requirements, and a plan drawn for one set of conditions cannot be applied directly to an airport with a different operational program. The airport planner is more concerned with the planning process, or the handling of the various considerations that lead to the final functional plan. The references to the New York International Airport that appear in this article should therefore be considered mainly as illustrations, because we are here concerned with the evolution of the functional plan for the terminal facilities rather than with a description of the exact physical plan adopted.

There are two approaches to the design of an airport passenger terminal—the single-building, or centralized terminal, and the unit arrangement, or decentralized terminal. New York International Airport is an example of the second type. This ten-building "Terminal City," now under construction, may well become an example of the high level of passenger comfort and of airline operational efficiency that can be achieved through the "unit terminal" type of design.

Any terminal must include the following considerations.

The functional planning of any airport facility, passenger terminal, cargo building, runway system or anything else, should not be undertaken until the mission of the airport is defined in a master plan. The master plan for New York International Airport underwent several changes, but the one in effect when the functional planning now under consideration was begun in 1950, contemplated:

1. An open parallel runway pattern to handle 100 movements per hour.

2. The operation of an integrated four-airport system (including La Guardia, Newark and Teterboro Airports) to serve the New Jersey-New York metropolitan region, in which New York International would serve the following part of the region's traffic: international and overseas, 100 percent; long-haul domestic, 50 percent; and short- and medium-haul domestic, 25 percent.

One of the major problems in planning the passenger terminal grew out of the changing concept of the airport or its role as defined by the master plan of the regional airport system. It is most important that the airport mission be clearly defined in the master plan; then the terminal-building process can be broken down into four major steps—design criteria, assumptions, space requirements, and functional plan.

An airport terminal building may be defined as an expensive but necessary facility for the efficient processing of passengers between surface vehicles and aircraft. The responsibility of the planner, then, is to emphasize the positive, or "efficient" aspects of the terminal while minimizing the negative or "expensive" aspects. This suggests a number of design criteria that are basic to any terminal plan, despite the role or magnitude of operations at a particular airport.

The passenger's desires are the prime consideration of the aviation industry. If they are to be satisfied so that he will make the greater use of air transportation that is expected, he must have, besides faster, more extensive and more frequent service, terminals designed for his convenience. From this comes the first design criterion:

The passenger's movements through the terminal building between ground transport and air transport facilities must be direct and unimpeded.

Terminal operations represent a considerable expense to both the airlines and the airport operator, and aircraft terminal time is an increasingly critical factor in economical air carrier operations. Therefore:

The building must provide a sound operational plan for the airline and airport operator.

These first two criteria would generally produce a building having tremendous construction and operating costs. The major non-operator source of terminal revenue is consumer services. Therefore:

The building must encourage maximum development of concessions.

The above are the three basic or all-inclusive design criteria for terminal planning but a much greater number of more detailed criteria must be considered of course. The first, direct and unimpeded passenger movement, for example, should be refined to include a requirement that the movement of baggage, air freight, express, mail and building services will not interfere with the flow of passengers. The second, operational efficiency, for another example, should be understood to include

workability during all periods—peak, average and slack. No attempt will be made in this article to catalogue all design criteria, although five more will be cited in the following sections on assumptions and space requirements.

The next step in the building planning process is to establish basic assumptions, that is, the functional principles relating to the mission of the airport, such as future passenger and aircraft ground handling practices. These assumptions are merely the planner's guess as to future operational practices; they are not controlling decisions. The dynamic nature of the aviation industry imposes a great burden on the planner, and he must carry it by introducing another design criterion:

The terminal design must be versatile and adaptable to unforeseen requirements.

The following are some of the assumptions on which the early planning for a terminal building for the New York International Airport was based:

Aircraft gross weight is critical and the necessity for passenger check-in, accurate manifest and individual flight clearances is ever present. Thus the first assumption:

1. Present airline practices with respect to passenger handling and flight clearance will be continued.

Today the airlines operate individually, although consolidation of noncompetitive functions, such as baggage handling and apron service, is practiced at some stations. Furthermore there appears to be a good possibility of further consolidation, considering the theoretical economies that could be realized. Therefore:

2. The basic terminal scheme should be adaptable to both consolidated and individual airline operation.

The interrelationship of the several functions of an air terminal is generally understood. However, for an extensive development, it is well to identify these functions in order of their interest to the airline passenger. This can be expressed in a third assumption:

3. The pertinent elements in order of interest to the embarking passenger are:

(*a*) vehicular unloading zone or parking lot, (*b*) airline ticket and baggage counters, (*c*) concessions, toilets and waiting room, and (*d*) aircraft departure gate. For debarkers, the inverse order is applicable: (*a*) aircraft arrival gate, (*b*) federal inspection (international passengers only), (c) same as above, (*d*) baggage claim counter, (*e*) vehicular loading zone or parking lot.

Present rapid development suggests that the aircraft of the future may differ considerably in size, speed, shape and power. Therefore the apron and finger structure must be flexible to meet future requirements. On the other hand, it is reasonable to assume that:

4. Future aircraft will continue to be taxied or mechanically moved into gate positions, thus permitting direct loading of passengers from terminal building to aircraft.

The foregoing assumptions suggest two pertinent conclusions that are derived also from the design criteria:

The centralized terminal scheme is desirable in all basic air terminal planning.

There has been considerable discussion of the merits of the centralized or "single" building scheme as against the decentralized "unit terminal" concept. Notwithstanding, considering relative versatility, space economy, potential concession income and efficient round-the-clock operation, centralization is preferable, providing the three principal design criteria mentioned above can be met.

The desirable aircraft parking arrangement is one of "fingering."

The aircraft parking arrangement on the apron influences the layout of the terminal building. To accommodate large numbers of aircraft two major arrangements are possible: (*a*) a single line of gates parallel to the terminal building, and (*b*) a pier arrangement extending approximately normal to the main building with aircraft parked on both sides of each pier or finger. The latter is the more reasonable considering average passenger walking distance.

The analysis of design criteria and basic assumptions permits the development of a functional flow diagram, which is given dimensions with the third step—consideration of space requirements, including gate positions. It would be folly to premise any planning of space requirements on arbitrary judgment, regardless of the experience on which such judgment rests. Estimates of space requirements can be made only after a detailed economic study which includes: (1) the mission of the airport, (2) traffic forecasts, (3) space use, and (4) revenue potential. Since there are limitations to even the most reliable study, another design criterion is here suggested.

The passenger terminal should be premised on the traffic analyses and forecasts assumed in the master plan, but it should anticipate the possibility that actual traffic will exceed forecasts. There is, though, an ultimate limit to traffic growth—runway capacity. Then:

The ultimate central building scheme should be scaled to the capacity of the airport's runways.

A central terminal constructed to ultimate requirements would of course be too large for initial needs. While certain construction savings might be realized by building to ultimate needs in a single stage, these are more than offset by the cost of excess early capital requirements. In addition, an unnecessarily large building would create unnecessary obstacles to the achievement of the first three criteria—passenger convenience, operational efficiency and concession development. This suggests still another design criterion:

The building should be planned to initial requirements with provisions for economical expansion by stages, so that each succeeding plan will be efficient and economical in itself.

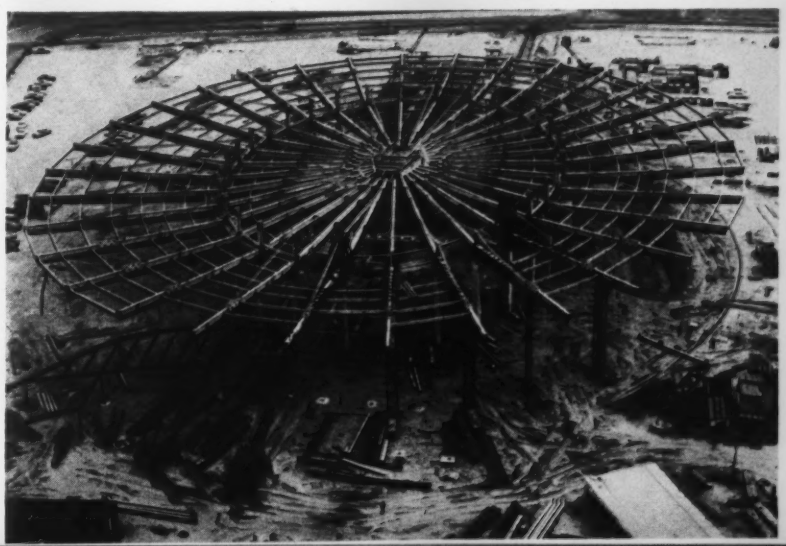
Functional plan

The functional planning for a terminal building for New York International Airport in 1953 was based on:

1. The overseas and long-haul domestic mission of the airport defined in the Regional System Master Plan, described above.

2. A traffic projection of 1,340,000

Roof skeleton for Pan American Airways' new passenger terminal at New York International Airport is a 2,000-ton steel wheel erected by Lehigh Structural Steel Co.



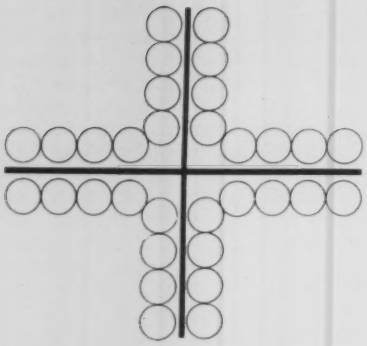


FIG. 1. Flow diagram provides minimum passenger walking distances to gate positions, with all passengers passing through concession area.

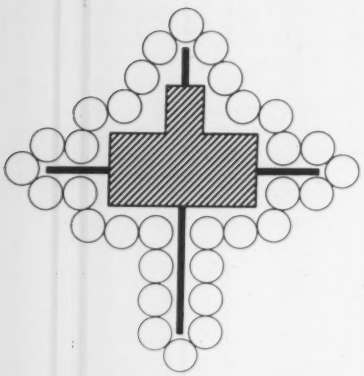


FIG. 2. Flow diagram of Fig. 1 has space added for ticket sale, concessions, and federal inspection.

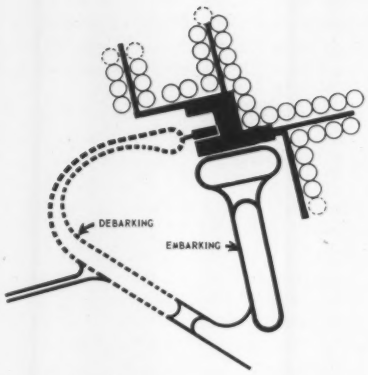


FIG. 3. Flow diagram of Fig. 2 has loading fingers relocated to provide access for ground transportation.

overseas and 4,060,000 domestic passengers annually by 1965.

3. A total of 32 gates and 36 aircraft loading positions expandable to 50, and 123,000 sq ft of floor space, divided 28 percent for airlines and associated services, 30 percent for consumer services and general offices, and 42 percent for public areas and airport operator space, plus a federal inspection wing of 118,000 sq ft.

4. A construction cost of $25 million, amortized over 20 years, with 50 percent of the terminal revenues derived from consumer services and offices.

A number of functional plans embodying the above were developed. The final one, known as Scheme E, grew out of an idealized functional flow diagram (Fig. 1), that gave minimum passenger walking distances, a tight operational plan and maximum gate positions, with all passengers passing a central point, as required, in that order, by the first three basic design criteria listed above. Space for ticketing and concessions and federal inspection services was added (Fig. 2), and provision for ground transportation access (Fig. 3). The western finger was first moved to provide ground transportation access, and then the northern finger was moved to provide a second ground-access route, which permitted the separation of incoming and outgoing traffic while avoiding the need for a costly two-level, single-route roadway.

In this final design, departing passengers were to enter the building and be ticketed on the ground floor, proceed by escalator to the second-floor waiting lounge, where consumer services were grouped, and walk through the second floor of the fingers to their loading gate, where they descended stairs to the ramp. Arriving passengers were to ascend stairs to the second floor of the fingers and proceed to the main passenger concourse, where they descended to the first-floor baggage-claim area. (International passengers would go to the second floor for Customs inspection.) Space for airline operations, utilities, and other services was located on the first floor. A restaurant was planned for the third floor.

The handling of three problems raised by Scheme E are illustrative of the practical decisions the planner must make. The problems included the possible inadequacy of the number of gate positions, the possible need for a second baggage-claim area at the south end of the terminal, and the location of Customs on the second floor.

Regarding the first, two plans had been prepared to cover the possible need for additional loading gates in the future. One (Fig. 4) called for the extension of the loading fingers and the installation of moving sidewalks to compensate for the great passenger counter-to-gate distance that would be created, and the other called for the setting up of aircraft service positions away from the terminal building to reduce gate time and consequently increase gate capacity. The latter was rejected because of the additional airline personnel and expense such an operation would require, and the former, which provided for a possible expansion to fifty gates, was adopted.

Provision had been made in the terminal plans for the possible later addition of a second baggage-claim area, as required, but the then overriding objection to the immediate inclusion of such a feature and to the location of Customs elsewhere than on the second floor was the adverse effect they would have on consumer service revenues. The estimate that consumer services

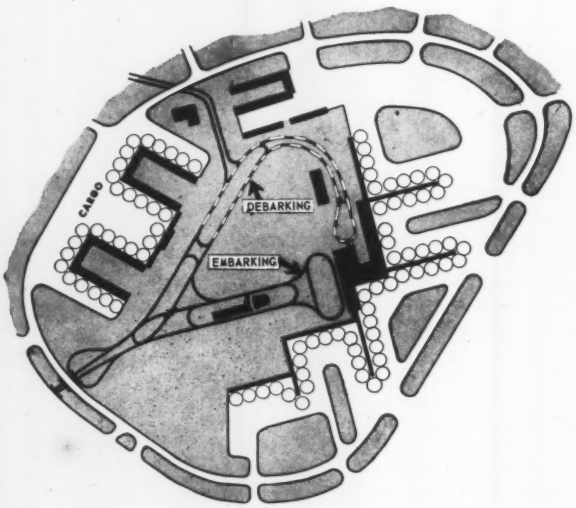


FIG. 4. One centralized plan, prepared to meet possible future need for additional loading gates, called for extension of loading fingers and installation of moving sidewalks to compensate for long counter-to-gate distance passengers must traverse (Scheme E).

would produce over half of terminal revenues was based on the plan which directed all passengers through a central concession area. Such revenues could not be realized if the plan were modified to divide passenger flow or to make the concession area less convenient.

At this point, though, it became apparent that more gates would be required in the initial and expansion stages, which made a centralized terminal plan like Scheme E impractical and which indicated the need for a unit terminal or decentralized plan. The requirement for more gates was created by revised traffic forecasts and aircraft gate-time assumptions. The forecast of 5,400,000 passengers annually by 1965, which had been agreed upon generally until late 1953, was replaced with a new forecast which indicated that this traffic level would be reached by 1960. The new forecast differed from that in the Master Plan mainly in the division of traffic between the regional airports; the forecast of regional traffic apparently was essentially the same. The assumption of aircraft gate time, which also had been agreed upon generally until 1953, was revised upwards. The total result was a need for a 50-gate initial stage with later expansion. See Figs. 5 and 6.

Terminal city

Decentralized or unit terminal plans for New York International had been under consideration since 1947, but based on the operational plan that had generally been agreed upon until late 1953, a centralized terminal was advantageous for the reasons listed above. The first firm indication of airline interest in a unit terminal plan came in February 1954 in a letter that said:

> We would much prefer a separate or unit terminal of our own. . . . We believe that such a unit terminal . . . would solve many of the serious operating disadvantages inherent in the central terminal of the magnitude contemplated . . . We also believe that the size of our operation would make possible sound development of concession revenues. This volume would be comparable, for example, to the total existing at Detroit Airport today. Concession activities at that airport are considered very successful.

This proposal did represent a partial solution to the problem, of course, but while one airline's withdrawal from the central terminal would provide it with adequate space and gates and make additional space and gates available to the remaining carriers, it would also endanger the economics on which the central terminal was premised. At this time, also, two other major carriers indicated a similar though not quite so firm an interest in a unit terminal.

The complete solution, then, was a fully decentralized terminal. Therefore, in March 1954, Scheme E was scrapped and a preliminary functional plan for a unit terminal was presented. The plan was refined and final agreement between the Port Authority and the airlines was reached in February 1955. Essentially, the plan adopted (Figs. 7 and 8) consists of several unit terminal sites on the periphery of the central area, with common public parking lots in the interior. All the terminal buildings were to be constructed by individual airlines or groups of airlines except for one group of buildings known as the International Arrival and Airline Wing Buildings, to be constructed by the Port Authority.

In December 1957, the first three buildings, the International Arrival and two Foreign-Flag Airline Wing Buildings, went into operation. Four unit terminals will be completed this year, one probably before this is published, and construction is well along on two more. Last year, arrangements were made for the ultimate replacement of the temporary terminal with a modern central terminal to serve carriers that will not have their own units.

The advantages of the Terminal City development for New York International are obvious, especially in view of the remarkable recent growth of air travel and the present forecasts, which indicate that this one airport will be handling 11,500,000 passengers a year by 1965. A central terminal building to serve this volume might well be over two miles long, and such a building would create prohibitive passenger walking distances and an inefficient operational plan. In addition, it would not provide adequate loading gates and would force the airlines into an undesirable remote-loading operation. The Terminal City unit terminal concept, by contrast, minimizes passenger walking distances, eliminates congestion by dividing traffic into manageable units, provides the maximum in flexibility, and permits each of the major carriers to plan for its individual operational needs, and finally, it provides for 140 aircraft loading gates.

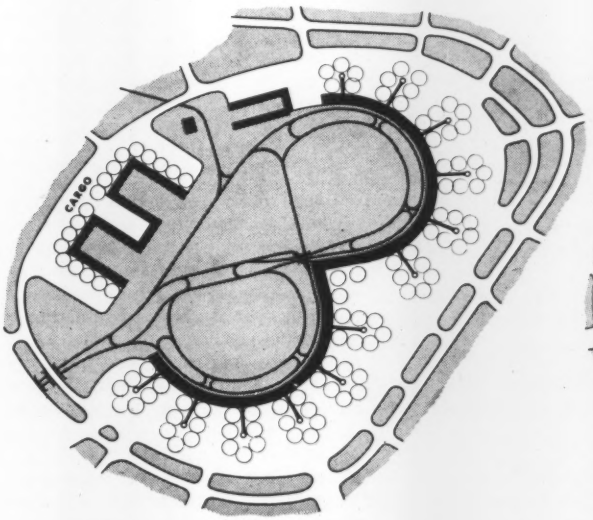


FIG. 5. Preliminary study in 1953 for a unit terminal at New York International Airport.

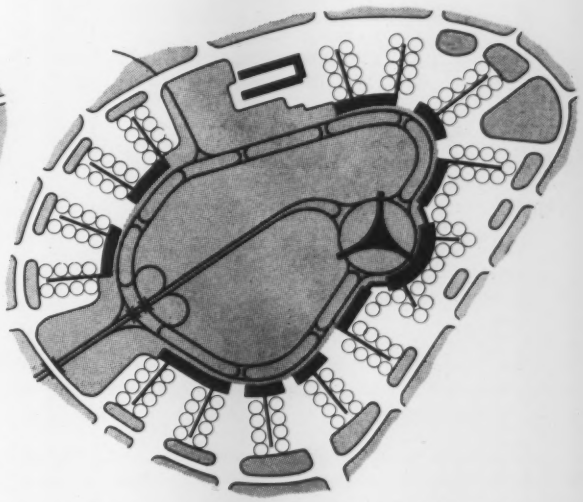


FIG. 6. In 1954 tentative plan for a "Terminal City," air cargo center is no longer placed in central passenger area.

Concession revenues for the various unit terminals will not represent as great a portion of total terminal revenues as was anticipated for the centralized operation, and they will probably be smaller than the portion experienced at the other regional airline airports. However, because of the great volumes of traffic that the individual airline unit terminals will serve, it will be possible for each of them to develop significant concession activities, using principles described above.

This article opened with a statement that each airport has unique passenger terminal requirements. Lest anyone should not heed this statement and feel that the terminal development at New York International Airport can be directly compared to any other airport, it closes with the observation that each of the individual terminal buildings at New York International is designed to handle a level of passenger traffic that would place it among the busiest airports in the world today.

While designing terminal facilities at the four airports operated by the Port of New York Authority, I often read three lines inscribed on the paperweight on my desk, and I recommend to the airport planner these words of the architect Burham:

"Make no little plans;
They have no magic to stir men's souls
And of themselves will not be realized."

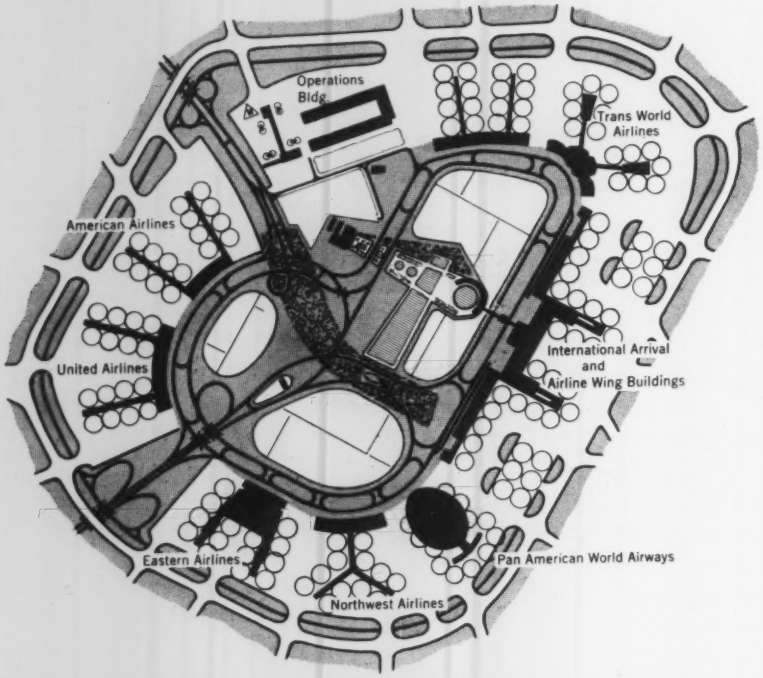


FIG. 7. Final plan (1955) for "Terminal City" at New York International Airport indicates final sites and designs for unit terminals.

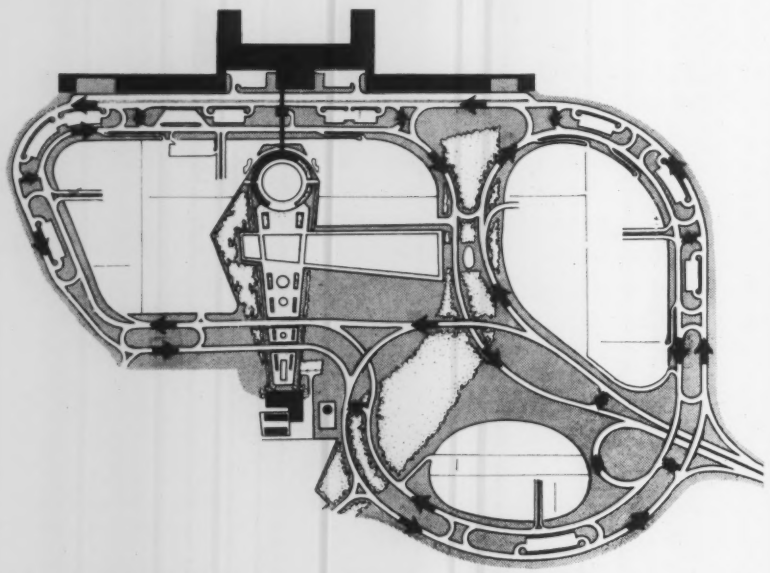


FIG. 8. Terminal buildings are served by a unidirectional, dual-lane recirculating roadway system without grade crossings.

NEW YORK INTERNATIONAL AIRPORT

Terminal Building

Large panels of plate glass are used for the facade, supported by horizontal and vertical anodized aluminum members. The use of plate glass gives a light feeling in contrast to masonry. The anodized aluminum was chosen for its resistance to weathering and to salt air at this ocean-front site.

The ramp, or working side of the building, features pale green Spandrelite, an opaque glass material, with stainless steel window frames. Spandrelite has proved more successful than other materials in preventing damage to the metal skin due to interior condensation.

Double glazing for the "picture" windows of the swanky third-floor restaurant provides an insulating barrier against heat, cold and sound.

Central Heating and Refrigeration Plant

Use of plate glass for an entire wall of the plant that provides heating and cooling for the Central Terminal Area makes it a show place. Interior equipment, visible through the glass facade, is given special color treatment. Refrigeration machines are painted an off white, high-temperature hot-water piping is red, chilled-water lines are green, condenser-water lines blue, and so on.

Other exterior walls of this building are of glazed face-brick with interior of glazed block for ease in cleaning and maintenance. For economy, structural steel is left exposed in walls and roof—and painted black. Roof insulation was omitted as plant heat is adequate.

Washington's National Airport is among the five busiest airfields in the United States. Its asphalt pavement was built on filled ground bordering Potomac River.

Asphalt pavement proved for jets by Columbus AFB test

ARVIN S. WELLBORN, M. ASCE, Chief Engineer and Secretary, The Asphalt Institute, College Park, Md.

Asphalt concrete, work-horse pavement in the age of the light airplane, is prepared to fill the same role in the Jet Age. It presented its credentials before a special investigating subcommittee of the Congress last December and they were found to be in good order.

The validity of modern asphalt design was established in a test conducted last year at the Columbus (Mississippi) Air Force Base. Here, on a 200-ft section of runway constructed by the Corps of Engineers, U.S. Army, a simulated B-52 gear loading of 212,000 lb supported on 266-psi tires was applied to the pavement in 20,000 passes. This was calculated to be equivalent to twenty years of normal year-round use by B-52 bombers.

The test, climaxing nearly five years of dragging debate between Air Force administrators and an economy-minded House Armed Services Committee, fully certified asphalt pavement design for very heavy wheel loads. Reporting back to the Congress, the Corps of Engineers stated as its primary conclusion:

"Considering normal B-52 operations only, we have concluded that the tests at Columbus Air Force Base demonstrated the validity of the design and construction procedures developed by the Corps of Engineers for heavy-load flexible runway interior pavements." (For the complete statement see p. 93 of this issue.)

The Corps also reported that "the surface smoothness within the traffic lane itself after completion of the test complied essentially with the smoothness tolerance allowed during construction."

On the strength of the Corps' report, with the Air Force concurring, the Congressional Subcommittee for Special Investigations (of the House Armed Services Committee) in March brought out its own report, which recommended that asphalt paving be restored to a competitive position in military airfield construction according to the design proposed by the Corps of Engineers. This represented a signal victory for asphalt pavement, which had been excluded from competitive bidding by Air Force fiat in 1957.

In its conclusions, the Subcommittee declared:

"Neither the Air Force nor this subcommittee is warranted in substituting their judgment for that of the Corps of Engineers on whether or not alternate bids for concrete and asphalt runways should be invited. The test at Columbus answered that question. Neither the Air Force nor we have the competence to challenge the engineering conclusions of the Corps of Engineers."

The Subcommittee report went on to brush aside an Air Force reservation which would substitute an estimate of costs for actual alternate bids.

"The proof of market price (said the report) is the market itself. It would cost far less for the Government to issue specifications on the alternate criteria proven by the Corps of Engineers and have the construction industry furnish the answers. Probably the most mature and soundest competitive industry in America today is the construction industry. It wants to build. It will back up its bids with performance bonds. It is entitled to the opportunity of making its own market.

"What this industry needs on these engineering conclusions is not the prejudgment of a phantom Government estimator but an 'honest deck, dealt above the table'."

This bluntly worded Congressional Subcommittee statement was in the nature of a rebuke to Air Force policy makers who wanted to eliminate asphalt paving from all important domestic military air bases. Inevitably, this doctrinal attitude of the Air Force has damaged the prestige of asphalt construction in civil airfield design in spite of the fact that 9 of the 15 airports carrying the heaviest traffic in the United States feature asphalt-paved runways.

From an engineering point of view, the successful pavement test at Columbus last year represented a triumph of engineering over prejudice. It was a rewarding experience for the Corps of Engineers, which had confidently predicted that it could design and build an asphalt pavement that would meet all the runway requirements of the world's heaviest aircraft. Beyond that, the test fully vindicated the sound engineering approach of the Corps, which found itself designing beyond the known limits of asphalt technology to meet a challenge presented by factors that offered no precedent.

In tackling its assignment, the Corps noted that the pavement distress caused by the extremely heavy loads and channelized traffic pattern peculiar to Air Force bomber operations appeared to originate in the foundation courses. Therefore the essential weakness of the pavement might lie in a semi-consolidated state in these base courses. So the Corps performed some experimental proof rolling with marked success. Also, special attention was given to full compaction of the courses making up the structure of the asphalt pavement proper.

Densification of the sand-gravel and clay-gravel subbase was difficult enough, involving the need to maintain optimum moisture content during compaction. But the incessant rains that plagued the project throughout the spring and summer months caused saturation in the lower part of the sand-gravel subbase while at the same time an excessive amount of water was being added for densification in this course.

The upper subbase material originally was a clay-gravel, but the Corps found this plastic material unsuitable and lacking the necessary stability for an airfield pavement. However, it was regarded as sufficiently stable for use in the lower subbase course, 25 in. below the finished grade. This material was therefore excavated to a depth of 10 in. and replaced with non-plastic sand-gravel fill of higher stability.

Examination of this sand-gravel material indicated it might be subject to particle rearrangement under heavy loads. During construction, limestone dust was added to improve the "setting up" quality, although the material remained non-plastic and lacked sufficient bond between the particles to resist consolidation under heavy loads. Developments during the testing of the pavement appear to have confirmed this suspicion, as well as the engineering judgment that full proof rolling of the base and subbase courses at the proper moisture contents would have prevented any measurable deformation in the pavement.

Actually, a rearrangement of particles under load represents an increase in the bearing strength of the material. This was pointed out by the Corps in its report to the Subcommittee. One of the important lessons learned on the Columbus project was that adequate proof rolling of the base courses at proper moisture contents will prevent such later consolidation.

Based on what was learned at Columbus it was the consensus of engineers that lower courses of non-plastic sand and gravel should not be placed in layers thicker than 6 in. They should be compacted with a seven-wheel, 30-ton pneumatic-tire roller, or one loaded to four tons per wheel with tires inflated to 90 psi. Then, while the material is still slightly below optimum moisture content, thirty coverages should be applied with a 60-ton four-wheel proof roller with a tire pressure of at least 150 psi. This would be expected to reduce later consolidation by at least 85 percent.

Anticipating greater compaction under heavy wheel loads, the engineers designed the asphalt concrete binder and surface courses with a 20 percent reduction from optimum asphalt content for the test section. This resulted in an asphalt content of 4.5 percent for the surface course and 3.5 percent in the binder. This lean mix was subjected to breakdown rolling with a three-wheel steel-wheel roller loaded to 10 tons, which made a single coverage. Then followed six coverages with a 30-ton seven-wheel pneumatic-tire roller with a tire pressure of 90 psi.

Experimental use of the pneumatic-tire roller for breakdown rolling disclosed that the specified density of 98.5 (of a laboratory-compacted specimen) could be achieved with three coverages of this type of roller at lower mix temperatures. It was found that the mix temperature could be lowered from 300-325 deg F to 280-300 deg F with a corresponding decrease in breakdown rolling temperature from 270 deg F or higher down to 260 deg F.

The almost imperceptible differential settlement in the test pavement under the test-load traffic was discussed by the writer, as representative of The Asphalt Institute, in testimony before the Congressional Subcommittee last December. It was pointed out that the peculiar conditions of the test limited traffic to a lane 14 ft wide. Normal prototype traffic would be distributed over a 75-ft width of pavement.

It was brought out that, on the testimony offered by the Corps of Engineers, it would require normal operational taxiway use of the runway pavement over a period of six months to produce what was described by General Wilson of the Corps as a "slight grooving." There is no reason to expect a runway to be used as a taxiway for such an extended period.

Commenting further on the summary of findings, the writer stated:

"The problem of channelized consolidation of the pavement need never arise again. The one conspicuous lesson learned from the Columbus project was that additional compaction in the base structure of the pavement will eliminate 85 percent of the later consolidation under heavy wheeled traffic.

"And, speaking of this additional compactive effect of the test traffic, it is worth emphasizing at this point an observation made in General Wilson's statement and confirmed by General Brown (that pavement deflections did not increase with coverages and even

showed slight decrease at 5,000 coverages as compared to the value at 3,500 coverages—evidence that the strength of the material under the asphalt concrete increased with traffic).

"Mr. Chairman, this is a very significant point. The 200-ft test section of asphalt concrete pavement at Columbus Air Force Base has now received a simple and inexpensive sand-asphalt seal and at this moment it is a stronger, smoother, more durable pavement than it was when the testing began. And additional seals, applied over a span of years, can extend the service life of that pavement almost indefinitely."

The Asphalt Institute never has conceded the need for constructing a rigid runway center strip, the so-called "insurance" compromise proposed by the Corps of Engineers. (See p. 93.) Under normal operational conditions, this application of taxiway design to the runway is unwarranted on military airfields and economically indefensible on civil airfields from an engineering standpoint.

The pavement design and construction procedures developed by the Corps of Engineers at Columbus clearly demonstrate that asphalt pavement can serve the requirements of our heaviest civilian jet transports, in existence or contemplated in the future. As the report of the House Subcommittee stated in its preamble, "It seems generally agreed that asphalt runways can be installed at less than the cost of cement." [Probably concrete was intended. Editor]

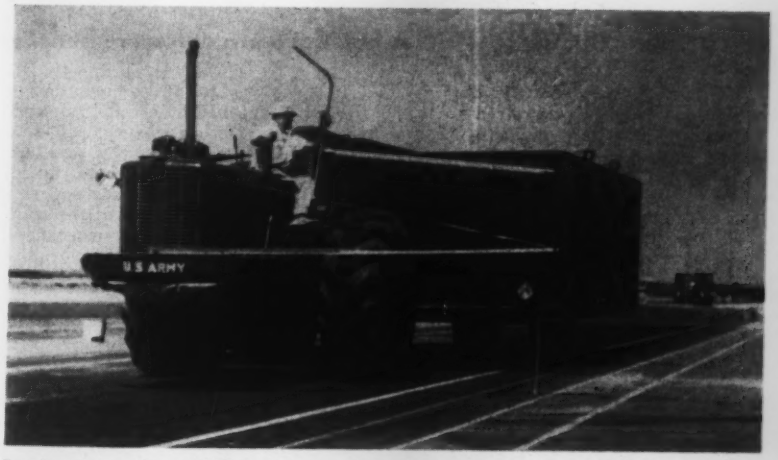
I earnestly recommend to the engineering fraternity a serious study of the design criteria developed from the test section built at Columbus Air Force Base. These criteria point the way to a sensible engineering answer to the challenge of the Jet Age for military aircraft. Existing criteria, contained in the design manuals of the CAA, offer a ready answer to the problem of serving the new jet civilian transports.

In response to a survey made by The Asphalt Institute, the principal manufacturers of the large jet transports confirmed that present asphalt pavement design is adequate to accommodate their new craft. They added that there are no jet craft on the drawing boards today that will impose any heavier wheel loading than piston-engine planes of known dimensions.

With these facts at their disposal, the design engineers of America can face the cloudy world of the Jet Age, secure in the knowledge that asphalt, the reliable work-horse pavement of the Propeller Age, remains a sturdy engineering staff to lean upon.

A vibrating steel-drum roller was used to compact the granular subbase on test pavement at Columbus Air Force Base.

Grade line is being checked during laying of asphalt concrete binder course for test pavement at Columbus Air Force Base. Meticulous care in construction marked this pavement project.



Load cart completes 3,000 coverages on test asphalt pavement constructed by Corps of Engineers at Columbus (Miss.) Air Force Base. Early consolidation in base courses under the pavement was limited and no further surface deflection was detected as test wore on.

ENGINEERS' NOTEBOOK

Water in the subgrade—a pavement problem

J. J. GALVAN, Soils-Materials Engineer, Homer L. Chastain & Associates, Consulting Engineers, Decatur, Ill.

It is common practice in pavement construction to place porous, cohesionless material for base and subbase directly on the subgrade. The purpose is to obtain good bearing capacity and to provide proper drainage of the subbase, particularly in areas of heavy rainfall or where the water table is near the subgrade and the subsoil is predominantly clay.

Frequently, after the granular subbase has been placed, rain penetrates the porous material, reaching the subgrade and softening it. This problem may be aggravated in expressway and airfield construction. Wide and nearly flat areas hold the water. Some of the water infiltrates the natural soil, saturating the upper layer, which becomes muddy. The softened surface becomes uneven because of the weight of the material above and vehicles running over it during compaction of the base or subbase.

Unevenness of the surface of the subgrade prevents the free flow of the water to the drains and holds it for some time. Unevennesses of this sort will never disappear. If this phenomenon occurs just before the area is paved, and a short time before freezing occurs, the captive water will swell as it freezes, exerting an upward stress and pushing up the concrete slabs or asphalt mat.

This is what has happened, in my opinion, on many sections of the Illinois Tollway. It accounts for the fact that the bituminous shoulders (4 ft and 11 ft in width) are higher than the concrete slab, in some places by as much as 1¼ in. The bituminous mat is much lighter than the concrete, and the upward pressure of the freezing water has easily overcome the weight of the bituminous surfacing.

To prevent uplift of this type it is recommended that dry and leveled natural-soil subgrade be covered with a prime coat of cutback asphalt. Type M.C. 0 or M.C. 1 should be used, according to the soil type, in the amount of about 0.2 gal per sq yd. When the cutback asphalt has dried (generally in 24 hours), the granular base or subbase can be placed.

This membrane will waterproof the surface of the natural subgrade so that the free water, which percolates through the layer of granular material, will escape instead of penetrating the underlying soil, altering its moisture content and destroying its stability. Also, free water from the granular subbase or base will escape more rapidly because of the minimum resistance it will encounter as it moves along the sealed layer—that is, the top of the subgrade.

This process is similar to the old method of utilizing a waterproof membrane to prevent the rise of capillary water in case any is present.

THE READERS WRITE

A healthy private practice benefits all

To THE EDITOR: Considerable attention has recently been given to the question of what the participation of private consulting firms should be in the planning, design and supervision of public works programs, especially the National Interstate Highway System. I believe adequate consideration has not been given to one aspect of this problem that is of foremost significance to every civil engineer.

The number of civil engineers employed in public service exceeds that of any other professional group. Before the last war, a graduating engineer seeking a professional career had only limited alternatives before him. The growth of a vigorous private practice in the past decade created new and attractive opportunities for graduates. In many cases, these positions provided higher salaries for beginners than were permitted in civil service regulations.

It is obvious that these circumstances worked to the benefit of all civil engineers. Public officials were compelled to reappraise their salary scales and advancement procedures in order to remain competitive in attracting new employees. As a result, many engineers in public employ received substantial benefits from the existence of a healthy private practice without being directly associated with it.

Today there has appeared in some areas of the profession, and in some public agencies, a desire to limit or eliminate the participation of private consultants in the highway program. Experienced consultants have been compelled to sharply reevaluate their prospects, consolidate staffs and curtail recruiting programs. It is probable that the 1959 graduating civil engineer will be presented with fewer opportunities for private employment, and this change in prospect may well make a civil engineering education less attractive to the entering freshman. Thus, during a period when the need for more qualified professionals is universally forecast, the civil engineering field may suffer curtailment.

Undeniably, a career in public service can be rewarding and commendable, in some ways superior to the satisfactions of private practice. But it would seem that limiting the opportunities of choice and the benefit of comparative and competitive salaries and advancement procedures, will be detrimental to all civil engineers. A healthy and continuing field of private practice is essential if civil engineering is to grow and flourish as a true profession.

DONALD R. GOODKIND, A.M. ASCE
Goodkind & O'Dea
Consulting Engineers
Bloomfield, N. J.

More on pile loading tests

To the Editor: The article in the February issue, "Finding Bearing of a 24-in. Pile by a Load on a 16-in. Pile" (vol. p. 101), by Douglas Brown, J.M. ASCE, was very interesting. The method proposed by him has several limitations, as discussed in the article.

In instances where equipment does not permit testing full-size piles, or where several pile sizes are considered in design, accurate evaluation of skin friction and point bearing can be obtained by testing two sizes (cross-sections) of piles (having equal lengths). For example, in the problem discussed by Mr. Brown, a load test on a 12-in. pile, as well as on a 16-in. pile, would have furnished the required information, as follows:

B = ultimate load determined by test
A_p = end area
A_s = perimeter area
Q = unit end bearing
S = unit skin friction

Then

$$B_{16} = (A_{p16})\ (Q) + (A_{s16})\ (S)$$

and

$$B_{12} = (A_{p12})\ (Q) + (A_{s12})\ (S)$$

After completing the two load tests, all terms in the above equations except Q and S would be known. Solving the two equations simultaneously would yield values for Q and S, which could then be applied to piles of other sizes. This approach would eliminate the possibility of results lying within the indeterminate range and would provide a double check on soil data.

J. R. Birdwell, J.M. ASCE
Spencer J. Buchanan and Associates, Inc. Consulting Engineers
Bryan, Tex.

To the Editor: In his article, "Finding Bearing of a 24-in. Pile by a Load on a 16-in. Pile," in the February issue (vol. p. 101), Mr. Brown presents an analysis of a pile loading test as an indeterminate problem unless an anchor pile fails. Actually, a loading test is a field shear test, from which the effective strength of the foundation material can be derived and applied to the design of a pile of any other size within the same depth. For the simple case of a foundation material of uniform strength ($\phi = 0$ deg), the load capacity of a cast-in-place pile is commonly determined by the equation,

$$Q = \gamma D \frac{\pi}{4} d^2 + 7.4c \frac{\pi}{4} d^2 + \pi d D c$$

where Q = pile capacity, in tons
d = pile diameter, in ft
γ = effective unit weight of the foundation material, in tons per cu ft
D = depth of penetration, in ft
c = shear strength of the foundation material, in tons per sq ft

For soils in which the strength varies with depth, the same approach can be applied, using Terzaghi's bearing capacity factors.

Anchor piles should be designed so that they will not fail in tension, so that the test pile will be loaded to complete failure. This will permit a complete analysis of the ultimate load, the yield-point load, and the load that will produce any given allowable settlement.

Ralph R. W. Beene
Head, Soils Design Section Fort Worth District Corps of Engineers
Fort Worth, Tex.

Firth of Forth, longest bridge built by cantilever method

To the Editor: I would like to correct a claim concerning the Greater New Orleans Bridge that has now appeared in Civil Engineering on two separate occasions—in the June and December 1958 issues ("Greater New Orleans Bridge Completed," O. F. Sorgenfrei, M. ASCE, June, p. 432; and News Briefs, Dec., p. 957). In both cases it is stated that the bridge has the distinction of being the longest erected entirely by the cantilever method without falsework supports for the main span.

This distinction rightly belongs to a bridge erected some seventy years ago, the Firth of Forth Bridge in Scotland, which has two spans each of 1,710 ft. In the library of the firm I work for, there is an article reprinted from *Engineering* of Feb. 28, 1890, in which there are photographs which clearly show that not only was no falsework used on the main spans but also that the suspended spans were built on from the ends of the cantilevers to closure at the center. These facts are corroborated in the article itself.

Another bridge that was erected by the cantilever method without falsework, in the normally accepted sense, is the arch bridge over Sydney Harbor, Australia, with a span of 1,650 ft. The two halves of the bridge were built out as cantilevers, held in place by steel cables running in tunnels in the rock under the approaches and attached to the top-chord steelwork at a point directly over the bearings. Although some may contest this, I personally think that this bridge also can legitimately be considered as having been erected by the cantilever method, without main-span falsework. The slightly longer Bayonne Bridge, near New York, did have some falsework, I believe.

Having worked for a while on the New Orleans Bridge, I am naturally reluctant to detract from the accomplishments of the designers and builders but I feel that the credit for the distinction mentioned should be given where it rightfully belongs.

Peter E. Joselin, J.M. ASCE
Rendel, Palmer and Tritton Consulting Engineers (Formerly with Modjeski and Masters, New Orleans, La.)
London, England

Head-loss coefficients vary

To the Editor: The flow metering procedure outlined by W. J. Tudor (p. 64 of the January issue) is one that must be used with caution. The method depends upon a reasonably accurate knowledge of the head-loss coefficients for the gate valve over the range of travel of the valve disk, and generally these data are not readily available.

Tests by various experimenters have clearly shown that head-loss coefficients vary markedly with valve size, and also with geometry (disk, recesses, contours of flow passages, etc.) for the same size of valve. For example, different models of a 1½-in. gate valve, by the same manufacturer, have been found to vary as much as 50 percent in the loss coefficient for the same opening. Thus the equation for flow rate proposed by Mr. Tudor would be limited to the particular sizes and models of valves tested by him, and its numerical constants could not be expected to yield a ±10 percent accuracy for gate valves of other sizes and configurations.

Ronald E. Nece, J.M. ASCE
Ass't Prof. of Hydraulics Mass. Inst. of Technology
Cambridge, Mass.

Simplicity and accuracy in structural analysis

To the Editor: Mr. Zutraun's letter in the February 1959 issue (vol. p. 104) is of special interest to civil engineers because his method of determining deflection at any point of a rigid frame is much simpler and shorter than that of Mr. Heinz, published in the November 1958 issue (vol. p. 853). For structural analysis, civil engineers should use the simplest, shortest and at the same time the most accurate and reliable method, especially today when the shortage of engineering experts is becoming more critical.

The writer's method of using properties of the "ellipse of elasticity" for solving such problems is believed to be simpler, shorter, and more accurate than either that of Mr. Heinz or Mr. Zutraun. (See the writer's discussions of the following papers in the ASCE *Transactions:* No. 2130, 1942, pp. 176-181; No. 2152, 1942, pp. 1030-1033; No. 2224, 1944, pp. 967-968; No. 2249, 1945, pp. 940-943; No. 2260, 1945, pp. 1414, 1415; No. 2268, 1946, pp. 161-162; No.

2408, 1950, pp. 631-634; No. 2508, 1952, pp. 642-643.)

The writer's method also has the important advantage that the analysis can be checked at any step of the procedure, and most of the analytical work can be used for any type of loading. In some other methods the accuracy can be checked only after the time-consuming analysis is terminated. These facts have been confirmed by the writer's students and several experts in structural analysis. The writer's methods are thoroughly discussed in his new book (in preparation for printing), "Simplified Analysis of Frame, Arch, Shell and Other Space Structures."

The writer's opinion has been recently confirmed by Prof. Henry J. Cowan, A.M. ASCE, of the University of Sydney, Australia, in his article in the *Architectural Science Review* (vol. 2, No. 1, Nov. 1958). He states: "Statically indeterminate frames of considerable complexity can be solved by the classical methods developed by Castigliano, Mohr and Müller-Breslau. However, the labor is such that errors are likely to occur in the solution of the numerous equations, and the cost is very considerable. . . . Approaches which depart from these theories were later developed into practical design methods using successive approximations. However, this procedure requires a great deal of arithmetic. . . and the consequent chance of major errors makes elaborate checks a necessity. Moreover, each condition of loading presents a separate problem, calling for new calculations. . . ."

How important it is for the designing engineer to use simple methods of structural analysis, which permit easier checking for accuracy, is demonstrated again in the article, "Graphical Integration Aids Deflection Calculations by Virtual Work," by Prof. Charles W. Cunningham, in the March 1959 issue of CIVIL ENGINEERING. Mr. Cunningham compares the results of his calculations with those of Mr. Heinz and finds a considerable difference in his deflection value at Point 2 of the discussed example (0.2 in. instead of the 0.515 in. of Mr. Heinz, confirmed also by Mr. Zutraun).

The simplest way to check the accuracy would be to use the presented methods for some very simple statically indeterminate members, for example a beam fixed at one end and freely supported at the other, for which the deflection values are recorded in any engineering handbook. It can be found that the results of Mr. Heinz and Mr. Zutraun are approximately correct. The analytical principles of Müller-Breslau and Van den Broek, to which Mr. Cunningham refers, are absolutely correct.

J. J. POLIVKA, M. ASCE
J. J. Polivka & Associates
Engineers and Architects
Berkeley, Calif.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Hydraulics Division Conference

Hosts: Colorado Section, ASCE; Wyoming Section, ASCE; and Colorado State University

Engineering Auditorium, Colorado State University, Fort Collins, Colo. **July 1-3, 1959**

REGISTRATION

Aylesworth Hall:

Monday, June 29, 4:00 p.m. to 9:00 p.m.
Tuesday, June 30, 8:30 a.m. to 9:00 p.m.

Engineering Auditorium, Engineering Center:

Wednesday through Friday, 8:30 a.m. to 4:00 p.m.

Registration fee, $4.00. (Ladies and children, no charge.) Please do not send payment in advance.

TUESDAY, JUNE 30

Tour through Rocky Mountain National Park

A scenic family tour through Rocky Mountain National Park, a 300-mile trip over Trail Ridge Road (summit 12,183 ft), a good hard-surfaced road through the beautiful Colorado Rockies. Stops at points of hydraulic interest. Reservations for trip to be made by June 15. Checks for $10.00 per person (price includes lunch) should accompany all reservations, for children and adults alike. Trip starts at 7:00 a.m. and ends at 5:00 p.m.

WEDNESDAY MORNING, JULY 1

Sponsored by Committee on Hydraulic Structures

Presiding: C. E. Kindsvater, Chairman, Exec. Committee, and A. J. Peterka, Member, Hyd. Structures Committee

The Manifold Stilling Basin

MAURICE L. ALBERTSON, Director, Research Foundation, Colo. State Univ., Fort Collins; and GENE R. FIALA, Highway Design Engr., U. S. Bur. of Public Roads, Portland, Oreg.

The Vortex Chamber as an Automatic Flow-Control Device

RICHARD C. KOLF, Asst. Prof., and PAUL B. ZIELINSKI, Asst. Instructor, Marquette Univ., Milwaukee, Wis.

New Concepts in Tunnel Spillway Deflector-Bucket Design

T. J. RHONE and A. J. PETERKA, Engineers, Bur. of Reclamation, Denver, Colo.

LUNCHEON FOR CONFERENCE PARTICIPANTS

Wednesday, July 1

The speaker will be COLONEL HEINBERG, of the U. S. Military Academy, whose subject is "Hydraulic Experiences in Holland."

WEDNESDAY AFTERNOON, JULY 1

Sponsored by the Hydromechanics Committee

Presiding: Arthur T. Ippen, Vice-Chairman, Exec. Committee, and Donald R. F. Harleman, Member, Hydromechanics Committee

Symposium on Hydraulic Models, Part I

A Unified Concept of Dynamic Similarity in Fluid Models

DONALD R. F. HARLEMAN, Assoc. Prof. of Hydraulics, Mass. Inst. of Technology, Cambridge.

Significance and Application of Froude and Reynolds Numbers as Criteria for Similitude

H. K. LIU, Assoc. Civil Engr., and M. L. ALBERTSON, Director, Research Foundation, Colo. State Univ., Fort Collins.

Dynamic Similarity in Wave and Tidal Models

F. GERRITSEN, Assoc. Prof., Coastal Eng. Lab., Univ. of Florida, Gainesville.

Separation and Sealing of Inertia and Viscous Forces in Periodic Flows

GERSHON KULIN, Hydraulic Engr., Fluid Mech. Sect., Natn'l Bur. of Standards, Washington, D. C.

FAMILY WESTERN BARBECUE

Wednesday, July 1

6:00 p.m. **Aylesworth Hall**

Informal barbecue for delegates, wives, and families. Evening entertainment will follow the barbecue.

THURSDAY MORNING, JULY 2

Sponsored by the Tidal Hydraulics Committee

Presiding: J. B. Tiffany, Secretary, Exec. Committee, and L. P. Disney, Chairman, Tidal Hydraulics Committee

Symposium on Instrumentation

New Instruments Developed by USGS for Measurement of Tidal Flow

E. G. BARRON, Hydraulic Engr., Research Section, Surface Water Branch, U. S. Geological Survey, Columbus, Ohio.

Recent Development by Coast and Geodetic Survey of Equipment for Measurement and Remote Recording of Tides and Currents

A. J. GOODHEART, Div. of Tides and Currents, U. S. Coast and Geodetic Survey, Washington, D. C.

A Pressure-Type Tide and Wave Recorder

E. H. BOWLER, Instruments and Control Systems Lab., National Research Council of Canada, Ottawa.

Special Developments in Oceanographic Instruments

J. M. SNODGRASS, Head, Special Developments Div., Scripps Inst. of Oceanography, La Jolla, Calif.

THURSDAY AFTERNOON, July 2

Sponsored by the Sedimentation Committee

Presiding: Harold M. Martin, Member, Exec. Committee, and E. J. Carlson, Member, Sedimentation Committee

Sedimentation and Conservation on Western Arid Lands

H. V. PETERSON, Area Chief, Gen. Hydrology Branch, U. S. Geological Survey, Denver, Colo.

The Use of Ultrasonics in the Measurement of Suspended Sediment Size Distribution and Concentration

GORDON H. FLAMMER, Assist. Prof., Utah State Univ., Logan.

Sediment Transport in Alluvial Channels

DARYL B. SIMONS, and EVERETT V. RICHARDSON, Research Engrs., USGS, Fort Collins, Colo.

CONFERENCE BANQUET

Thursday, July 2

6:30 p.m. **CSU Student Union**

FRANCIS S. FRIEL, President of ASCE, will be the speaker at this banquet.

FRIDAY MORNING, JULY 3

Sponsored by Flood-Control Committee

Presiding: Maurice L. Dickinson, Member, Exec. Committee, and Arno Lenz, Member, Flood-Control Committee

Flood Control Problems in South Platte River Basin, Colorado

STANLEY A. MILLER, Supervisory Water Conservation Project Engr., Colo. Water Conservation Board, Denver.

Changes in Urban Occupance of Flood Plains in the United States

GILBERT F. WHITE, Chairman, Dept. of Geography, Univ. of Chicago, Chicago, Ill.

A New Approach to Local Flood Problems

GEN. HERBERT D. VOGEL, Chairman of the Board, Tennessee Valley Authority, Knoxville.

Suggested Legislation on Flood Plain Regulation

JOSEPH I. PERREY, Chief Engr., Ind. Flood Control and Water Resources Commission.

FRIDAY AFTERNOON, JULY 3

Sponsored by the Hydrology Committee

Presiding: A. R. Chamberlain, Co-Chairman, Fort Collins Hydraulics Conf., and V. A. Koelzer, Member, Hydrology Committee

Symposium on Use of Electronic Computers in Hydrology

Application of Electronic Computers to the Solution of Hydrologic Problems in the Bur. of Reclamation

FRANCIS E. SWAIN and H. S. RIESBOL, Bur. of Reclamation, Denver, Colo.

The Role of Electronic Computers in Hydrologic Studies of the TVA

W. M. SNYDER, Tennessee Valley Authority, Knoxville.

Columbia River System Power Analysis by Use of Digital Computer

DAVID J. LEWIS and LOREN A. SHOEMAKER, Corps of Engineers, U. S. Army, North Pacific Div., Portland, Ore.

Use of High-Speed Computing Equipment in Water Resources Investigations of U. S. Geological Survey

G. E. HARBECK, JR., and W. L. ISHERWOOD, U. S. Geological Survey, Denver, Colo.

LADIES PROGRAM

Tuesday, June 30

Ladies may accompany their husbands on the scenic tour of Rocky Mountain National Park (children too).

Wednesday, July 1

10:00 a.m. Informal coffee; style show (Western theme) Aylesworth Hall.

2:00 p.m. Tour of Home Economics Dept.
High-Altitude Lab., Textile Lab., Weaving and Ceramics, and a demonstration of electronic cooking. Refreshments at Guggenheim Hall.

6:00 p.m. Family Western Barbecue
Aylesworth Hall.

7:30 p.m. Family Fun Night
Square dancing, variety shows, etc.

Thursday, July 2

9:00 a.m. Trip to the Buckhorn Mountain Guest Ranch
Chuck Wagon lunch, outdoor activities.

6:00 p.m. Conference banquet

Friday, July 3

9:30 a.m. Informal coffee
Aylesworth Hall.

10:30 a.m. Tour of Occupational Therapy Lab.
Industrial Research Building.

CHILDREN'S PROGRAM

The program of entertainment and recreation includes a barbecue, square dancing, swimming parties and games of all sorts. The biggest thrill should be the day spent on a real Western dude ranch with chuck-wagon lunch, horseback riding, cowboys, etc. Baby sitters will be available for the very young while Mother is taking part in the ladies' activities.

SOCIETY NEWS

Cincinnati First in Nation to Top UEC Goals

All hail to Cincinnati—the first city in the country in which all Founder Society local sections have passed their goals in the United Engineering Center fund drive! The total pledged by Cincinnatians now (April 16) stands at $45,120. Although all quotas have been reached, this does not mean 100 percent participation of Cincinnati engineers in the campaign. Thus the campaign to reach all Founder Society members who have not yet pledged, including new arrivals in Cincinnati, continues.

The Cincinnati Section of ASCE, under Prof. Cornelius Wandmacher, has topped its quota by 138 percent, with only 60 percent of its members contributing; the ASME section, by 163 percent, with only 53 percent of its members helping; the AIEE section, by 101 percent, with 59 percent of its members taking part; and the AIChE section, by 135 percent, with 85 percent of its members contributing. In addition, the Ohio Valley Section of the AIME (the fifth Founder Society) has pledged 135 percent of its quota. This section includes about fifty residents of Cincinnati.

Richard E. Dougherty, Past-President of ASCE and chairman of the National Member Gifts Campaign for the UEC, in extending his congratulations on this accomplishment, said, "Cincinnati, with a long history of excellent engineering society organizations, has made a fine demonstration of how well-unified efforts can achieve important goals for the engineering profession at large."

In Philadelphia and Indiana

Encouraging, too, is the attitude of the Philadelphia Section—sixth of the ASCE Sections to achieve its goal—which has voluntarily raised its quota by $10,000. The Section received a substantial gift in meeting its original quota of $20,000.

The Indiana Section—eleventh of the ASCE Sections to make the UEC Honor Roll—is also taking the kind of constructive approach to the campaign that will result in ultimate victory. Under the enthusiastic leadership of Chairman Don Corbett, the Section is arranging to make a personal appeal for contributions to the many construction companies and material suppliers in the state. Some of these companies have said they wanted to contribute after they had a chance to see "how sincere the membership" was in doing the job for themselves.

Cincinnati engineers mark their achievement as the first community in the country to go over the top in the Founder Societies drive for UEC funds. Ernest B. Fields, chairman of the Cincinnati Sponsor Group, receives a token of appreciation from local section representatives. Shown here, left to right, are Cornelius Wandmacher, chairman for Cincinnati Section, ASCE; Julian E. Tobey, Cincinnati representative, Ohio Valley Section, AIME; Mr. Fields; Lester L. Bosch, general chairman and chairman for Cincinnati Section, ASME; Kenneth H. Pettengill, chairman for Ohio Valley Section, AIChE; and Willard A. Farris, chairman for Cincinnati Section, AIEE.

Three More Sections on Honor Roll

The Society's Delaware, Kansas City, and Central Pennsylvania Sections have reached their goals and are twelfth, thirteenth, and fourteenth on the Honor Roll. District 4 is now doubly distinguished. Not only is it the first (and at the moment only) District to go over the top, but all four Sections within its confines —Lehigh Valley, Philadelphia, Delaware, and Central Pennsylvania—are on the Honor Roll.

The response of Sections outside the continental United States to the campaign has been heartening. Despite its 6,000 miles from New York and the proposed United Engineering Center, the Hawaii Section was among the first to demonstrate its awareness of the importance of the Center to the Society and the profession by passing its goal. The Puerto Rico Section, with 79 percent of its quota pledged, is nearing its goal —this in a country where dollars are hard to come by. The Venezuelan Section has contributed 35 percent of its quota, and the Alaska Section 36 percent.

Member Giving Rises

Though ASCE member giving, as a whole, has reached 57 percent of its goal and the average contribution is $63, only 7,162 members have contributed to the total pledged. Where are the rest of our 42,000 members? Member giving in the combined Societies is better, with 75 percent of the goal attained. With industry within 14 percent of meeting its quota, total subscriptions stand at 82 percent of our $8,000,000 goal.

Indefatigable Campaigners

Two tireless workers in the fund-raising cause are Walter Barrett, president of United Engineering Trustees, and Mervin J. Kelly, general chairman of the Industrial Building Fund Committee. Mr Barrett is currently making a coast-to-coast tour of leading cities to acquaint

engineers with the details about the Center. From the outset of the campaign Mr. Kelly has been instrumental in the success of the drive for contributions from industry, and is now devoting his entire time to it.

The need for the new United Engineering Center is apparent to all who have studied the problem. We would like to repeat Chairman Kelly's clear statement of the strong link between the profession, the Engineering Societies, and an adequate headquarters for the Societies and their working staffs. Said Mr. Kelly, "The Societies make large contributions to the nation's technologic strength through the many services they render to engineers. They provide a professional framework for engineers. They provide publications, meetings, and forums for presenting information on technologic progress. They aid in the development of young engineers through establishing standards for engineering education, through student branch activities, and through the impact of their publications on engineering curricula."

ASCE Giving Passes $457,498 as of April 10

Local Section	Quota	Amount Pledged	% Quota
ZONE I (1103)	$197,300	$126,932	64
District 1 (561)	**133,300**	**87,011**	**65**
Brazil (3)	2,100	90	4
Metropolitan (497)	119,200	82,269	69
Panama (3)	1,300	140	11
Puerto Rico (18)	3,100	2,460	79
Rep. Colombia (6)	2,400	230	10
Venezuelan (34)	5,200	1,822	35
District 2 (283)	**43,400**	**23,423**	**54**
Connecticut (96)	11,000	8,058	73
Maine (34)	4,700	2,535	54
Massachusetts (111)	23,000	9,797	43
New Hampshire (10)	1,800	438	25
Rhode Island (32)	2,900	2,595	89
District 3 (259)	**20,600**	**13,998**	**68**
Buffalo (50)	4,400	2,700	61
Ithaca (46)	2,400	2,719	113
Mohawk-Hudson (61)	7,500	3,018	40
Rochester (39)	1,900	2,199	116
Syracuse (55)	4,400	2,667	60
ZONE II (1695)	169,700	88,557	52
District 4 (562)	**34,000**	**37,516**	**110**
Delaware (96)	4,100	3,714	91*
Lehigh Valley (89)	4,200	5,517	131
Philadelphia (215)	20,000	22,675	113
Central Pa. (162)	5,700	5,610	98*
District 5 (263)	**27,000**	**7,315**	**27**
Nat'l Capital (263)	27,000	7,315	27
District 6 (407)	**49,000**	**18,931**	**39**
Maryland (151)	15,000	5,691	38
Pittsburgh (160)	17,000	7,788	46
Virginia (90)	13,300	4,376	33
West Virginia (6)	3,700	1,076	29
District 10 (463)	**59,700**	**22,295**	**37**
Alabama (54)	8,900	2,254	25
Florida (13)	11,500	1,205	10
Georgia (110)	11,000	6,863	62
Miami (8)	5,200	390	8
Nashville (56)	2,700	2,740	101
N. Carolina (33)	6,300	2,991	47
S. Carolina (91)	4,900	2,525	52
Tenn. Valley (98)	9,200	3,327	36
ZONE III (2107)	202,200	119,401	59
District 7 (308)	**39,900**	**13,112**	**33**
Duluth	1,500		
Michigan (46)	18,000	2,319	13
Northwestern (50)	8,000	2,060	26
Wisconsin (206)	10,700	8,598	80
S. Dakota (5)	1,700	110	6
District 8 (283)	**$37,100**	**25,322**	**68**
Cent. Ill. (52)	6,500	3,130	48
Illinois (201)	29,000	21,344	74
Tri-City (30)	1,600	848	53
District 9 (689)	**45,700**	**38,308**	**84**
Akron (31)	3,100	1,300	42
Central Ohio (117)	5,100	4,211	83
Cincinnati (124)	4,700	6,532	139
Cleveland (30)	9,300	3,900	42
Dayton (22)	3,300	1,986	60
Indiana (260)	11,000	13,499	123
Kentucky (104)	6,100	6,630	109
Toledo (1)	3,100	250	8
District 14 (184)	**31,500**	**13,622**	**43**
Mid-Missouri (19)	3,500	740	21
Mid-South (63)	11,000	5,534	50
Oklahoma (36)	6,900	2,279	33
St. Louis (66)	10,100	5,069	50
District 16 (643)	**48,000**	**26,537**	**55**
Colorado (40)	13,900	2,444	18
Iowa (97)	5,900	4,117	70
Kansas City (302)	12,000	12,282	102
Kansas (101)	7,000	3,499	46
Nebraska (88)	6,300	3,755	60
Wyoming (15)	2,300	440	19
ZONE IV (2179)	230,800	122,608	53
District 11 (1282)	**132,600**	**69,249**	**52**
Arizona (138)	5,000	4,889	98
Hawaii (211)	6,300	7,282	116
Intermountain (33)	4,700	1,084	23
Los Angeles (383)	50,200	19,747	39
Sacramento (171)	16,300	5,216	32
San Diego (58)	6,000	2,186	36
San Fran. (288)	44,100	28,845	65
District 12 (428)	**40,400**	**21,072**	**52**
Alaska (14)	2,200	790	36
Columbia (74)	2,200	2,803	127
Montana (15)	3,300	960	29
Oregon (67)	10,900	2,936	27
Seattle (99)	12,200	5,756	47
S. Idaho (31)	2,300	2,548	111
Spokane (48)	3,100	1,808	58
Tacoma (75)	4,200	3,291	78
District 15 (469)	**57,800**	**29,787**	**52**
Louisiana (55)	13,000	2,824	22
Mexico (1)	1,400	40	3
New Mexico (13)	4,000	705	18
Texas (400)	39,400	26,218	67
Totals (7,084)	$800,000	$457,498	57

Note: Number of pledges shown in parentheses
* Now (April 17) 100 percent

Table 1. Quotas and Pledges to UEC as of April 10

Society	Goals in Dollars	No. of Subscribers	Amount Pledged	% of Goal	$ per Subscriber
ASCE	800,000	7,162	454,667	57	63
AIME	500,000	3,395	252,588	51	74
ASME	800,000	9,624	475,299	59	49
AIEE	900,000	19,336	730,046	81	38
AIChE	300,000	6,788	287,102	96	42
Others	. . . .	567	44,360	. .	78
Total	* 3,000,000	46,872	$2,244,067	75	48
Industry	5,000,000	392	4,286,533	86	10,900
Grand Total	8,000,000	47,264	6,530,600	82	

* While the overall goal of member giving is shown as $3,000,000, the quotas accepted by the Societies total $3,300,000.

UEC HONOR ROLL

Congratulations, again, to the ASCE Local Sections that have not let meeting their quotas slow the drive for funds for the United Engineering Center. Several are pressing on toward goals of their own—presumably as much as they can collect. The growing list of Sections is repeated here. The Sections are listed in order of meeting their goals; and the figures indicate percentages of quota attained on April 17.

Kentucky (109)
Lehigh Valley (131)
Nashville (101)
Cincinnati (139)
Columbia (127)
Philadelphia (113)
Hawaii (116)
Rochester (116)
Ithaca (113)
Southern Idaho (111)
Indiana (123)
Delaware (100)
Kansas City (102)
Central Pennsylvania (100)

District 4 continues in solitary eminence —the only District that has exceeded its quota.

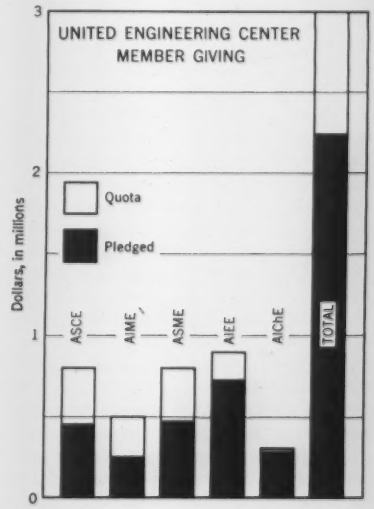


Fig. 1. Member giving for United Engineering Center as of April 10.

ASCE Honorary Member Gerard Matthes Dies

The Society has lost a distinguished member and good friend in the death of Gerard Matthes, which took place in New York City on April 8. He was 85.

Mr. Matthes had lived in New York since 1945 when he retired as director of the Waterways Experiment Station and consultant to the president of the Mississippi River Commission in Vicksburg. An authority on flood control, Mr. Matthes received the War Department's medal in 1944 for Exceptional Civilian Service in recognition of his work on Mississippi River flood control. He invented tetrahedral block revetments for river banks and improved the system of artificial cutoffs for the Mississippi.

Born in Amsterdam, the Netherlands, Mr. Matthes came to the United States in 1891 and became a citizen five years later. He graduated from Massachusetts Institute of Technology in 1895. In his earlier career he was with the U.S. Geological Survey, the Reclamation Service (now the Bureau of Reclamation), the Miami Conservancy District, and Fairchild Aerial Surveys, Inc. For most of the period from 1920 until his retirement in 1945 he was with the Corps of Engineers. He directed the first survey of the Tennessee River, and was principal engineer in the U.S. Engineer Office at Norfolk and head engineer in the Office of the President of the Mississippi River Commission. During the war years he was director of the Waterways Experiment Station.

Mr. Matthes had been a Member of ASCE since 1905 and an Honorary Member since 1945. Author of more than fifty articles on river hydraulics, flood control, and aerial photography, he was awarded the Society's Norman Medal in 1949 for a paper on Misssissippi River cutoffs. Recently Mr. Matthes contributed to a widely used handbook of American engineering practice.

Surveying and Mapping Positions Classified

At its February 1959 meeting in Los Angeles the Board of Direction adopted as Society policy a recommendation of the Task Committee on Surveying and Mapping that four major surveying and mapping categories be classified as a part of civil engineering and subject to engineering ethics. The four categories so classified are: land surveying, engineering surveying, geodetic surveying, and cartographic surveying. Brother B. Austin Barry, chairman of the Task Committee on the Status of Surveying and Mapping, gives some of the details of the Board action in the item that follows.

Certain committees of the Society are directed to work at implementing the Board's action. The Committee on Membership Qualification is asked to ascertain how to evaluate the professional-level experience of those applying for membership or advancement of grade in the Society. The Committee on Registration of Engineers is directed to work out details for assuring appropriate recognition of professional experience in surveying and mapping. The Engineering Education Committee is to study the amount and type of surveying and the emphasis to be accorded it in collegiate education. The Committee on Professional Practice is to develop the appropriate procedures for handling surveying and mapping on a professional basis.

The implications of the Board's action in Los Angeles are generally clear, although the guidance of these various committees will be needed during the transition period immediately ahead. ASCE cannot itself dictate to individuals or organizations, but should give direction and unity to the effort of placing the professional work of the four named surveying-mapping categories in proper perspective. Because ethics must serve as the basis of proper operation in the professional area, the Society must use its moral power to bring about adherence to proper procedures. The interpretation of existing and accepted Canons of Ethics that guide all engineering work is now specifically needed with regard to surveying and mapping. The practice of competitive-price bidding for surveying work of a professional nature must now be reassessed in the light of the Board's statement.

While surveying-mapping education is constantly under scrutiny by educators themselves and by committees especially set up to assess engineering education, the Board action brings into focus the professional importance of the subject. As mentioned in the Task Committee's final report, the surveying-mapping phases of engineering have been neglected in recent decades. They need to be restudied, lest the body of knowledge essential to the profession be lost and lest there be an acute shortage of competent personnel in this area. The Society's Engineering Education Committee is asked to evaluate this matter in proper perspective, working up recommendations.

The Surveying and Mapping Division is now actively cooperating with the four committees at work on the projects assigned them by the Board. The assistance of all members is invited.

Definition of Professional Positions

As a guide to the terms used for designating the several professional positions in the preceding outline, it is thought advisable here to include certain definitions. These accord generally with the accepted definitions given in the ASCE Manual No. 34, "Definitions of Surveying, Mapping, and Related Terms" 1954, but are altered somewhat to describe more clearly the particular job function envisioned in this outline.

Land or Property Surveyor determines location of land boundaries; prepares maps showing shapes and areas of land; divides land into smaller tracts, including layout of roads and streets and rights-of-way for same to give access to smaller tracts; prepares official plats or maps of such land subdivisions; prepares and interprets land descriptions for incorporation in deeds, leases, etc.

Survey Engineer obtains information for planning or developing an engineering project and estimating its cost, often recording such information in form of an engineering map or plat.

Geodetic Surveyor (or **Engineer**) plans, performs, or supervises high-accuracy surveys as well as the computations and adjustments thereof, including such as triangulation, traverse, precise leveling, and astronomic observations, such surveys being of a magnitude that the required accuracy and precision can be obtained only through processes that involve figure and size of the earth.

Survey Engineer (Control) plans, performs, or supervises surveys and computations of horizontal and vertical measurements involving complex network adjustments, etc.

Topographic Engineer plans, performs, or supervises the construction of topographic maps of any scale, contour interval, or accuracy specification, including all surveying procedures and calculations required for such map construction; determines when and whether ground or photogrammetric surveys or various combinations thereof shall be used.

Photogrammetric Engineer or **Photogrammetrist** plans, performs, or supervises use of photogrammetric instruments and techniques, in conjunction with various aspects of surveying, mapping, resource surveys, and the design of photo-interpretation systems.

Cartographer plans construction and compilation of charts and maps of small scale; assembles, evaluates, selects, and directs plotting of data therefor.

Map Editor performs many functions of the cartographer; especially designs form and content of maps; designs criteria for symbolization and nomenclature; reviews manuscript maps as to accuracy, completeness, correctness, and comformity with established standards.

The titles mathematician, electronic engineer, geographer, geophysicist, etc., are not defined here specifically, since they are primarily titles of persons in allied professions whose work only incidentally is in the field of surveying and mapping.

Classification Chart for Surveying and Mapping

	Professional Level ***	Technician or Pre-Professional Level ****
I. Land or Property Surveying (Cadastral)		
A. Property and Boundary Surveys*	Land Surveyor	Instrumentman
B. Subdivision Surveys and Plats*		Computer
C. Public Lands Surveys*		Draftsman
D. Surveys for Plans and Plats*		Tapeman
1. Architectural (Building-Site) Surveys		Rodman
2. Tax Maps		
II. Engineering Surveys for Design and Construction		
A. Design Data Surveys (including Route Surveys)*	Survey Engineer	Instrumentman
1. Control, Horizontal and Vertical		Computer
2. Culture and Topography		Draftsman
3. Profiles and Cross-Sections		Tapeman
B. Construction Surveys*		Rodman
1. Layout Surveys		
2. Quantity and Measurement Surveys		
3. "As-Built" Surveys		
a. Utility Surveys		
C. Mine Surveys		
III. Geodetic Surveying, Geodetic Engineering, or Geodesy (not to be confused with precise plane surveying)		
A. Control Surveys, First- and Second-Order Accuracy**	Geodetic Surveyor or Geodetic Engineer Mathematician	Instrumentman Observer Computer Gravimetric Operator Recorder Signalman Tapeman Rodman
1. Horizontal: triangulation, traverse, and electronic trilateration		
2. Vertical: spirit and trigonometric leveling		
B. Geodetic Astronomy		
C. Gravity Surveys, Magnetic Declination Surveys, Figure-of-the-Earth Studies		
IV. Cartographic Surveying, Cartographic Engineering, or Map and Chart Surveying (surveys for constructing original maps and similar products)		
A. Control Surveys, Third- and Fourth-Order Accuracy**	Topographic Engineer Hydrographic Engineer Photogrammetric Engineer Survey Engineer (Control) Geodetic Surveyor or Geodetic Engineer	Plane-Table Operator Instrumentman Observer Computer Recorder Draftsman Tapeman Rodman Stereo-Plotter Operator Observer Recorder Computer Draftsman Leadsman
1. Horizontal		
2. Vertical		
B. Topographic-Planimetric Surveys and Maps*		
1. Photogrammetric Aero-Triangulation		
2. Mapping Surveys		
a. Ground-Survey Methods		
b. Photogrammetric Methods		
3. Field-Edit Surveys of Photogrammetric Compilations		
C. Hydrographic Surveys**		
1. Soundings: fathometer, hand-lead, sounding pole		
2. Sounding Fixes: three-point, electronic		
3. Wire-Drag Surveys		
4. Tidal and Current Surveys		
V. Aerial Survey Services		
A. Aerial Photography	Photogrammetrist Photo-Interpreter Electronic Engineer Mathematician Geophysicist	Photographer Photo-lab Technician Photo Analyst Computer Electronic Technician Magnetometer Operator Radar-altimeter Operator
1. Photo-Interpretation		
B. Electrical Measurements for distances and position fixes (shoran, etc.)		
C. Airborne Magnetometer Surveys		
D. Radar-Altimeter Profiles and Elevations		
VI. Cartography (not requiring original surveys)		
A. Map Design	Cartographer Geographer Map Editor	Map Compiler Mosaicker Modeler Engraver Lithographer
B. Compilation derived from existing source data		
1. Evaluation of Maps and Other Source Data		
2. Nautical and Aeronautical Charts, Topographic and Plainmetric Maps, Special-Purpose Maps, etc.		
3. Photomaps and Mosaics		
4. Relief Maps and Models		
5. Radar-Prediction Charts		
C. Map Editing		
D. Map Reproduction		
1. Engraving or equivalent		
2. Lithography		

* Photogrammetric procedures used when applicable on these and other activities.

** Electronic measuring procedures used when applicable on these and other activities.

*** See definitions following this outline. Titles listed are intended to be illustrative, not inclusive.

**** Including some which are normally skilled craftsmen but which sometimes, by reason of special training, are properly considered technicians, e. g., rodman, tapeman, leadsman, signalman, etc.

EJC Named Sponsor for Technical Student Exchange

Engineers Joint Council has been named sponsor for the U.S. Committee of the International Association for the Exchange of Students for Technical Experience, and its secretariat is now located in EJC headquarters at 29 West 39th Street, New York 18, N. Y. The association is a non-government, non-profit organization founded at the Imperial College of London University in 1948 for the purpose of providing on-the-job training in foreign industry for student engineers and scientists. Its program began with an exchange of 920 students among ten Western European member countries. By the close of 1958 there had been an exchange of 39,996 students among the 26 countries participating in this international program.

Since 1955 the association has been sponsored by the Institute of International Education. The change-over to EJC sponsorship is made because of that organization's close contact with science and engineering as represented by industry. Under EJC sponsorship, the association will be closely allied with the EJC Committee on International Relations.

Josef Wischeidt Jr., is executive secretary of the U.S. International Association for the Exchange of Students for Technical Experience.

ECPD Guidance Brochures

Three new brochures to guide young engineers during their first few years after graduation are announced by the Training Committee of the Engineers' Council for Professional Development. Published in support of ECPD's First Five Year program, the brochures have been planned to help the young engineer find his place in professional practice and establish his own professional goals.

The new publications are "Your First Five Years," a general survey of the professional problems facing young engineers (price:10 cents); "Selected Reading for Young Engineers" (price: 15 cents); and "Personal Appraisal Questionnaire," designed to aid the young engineer in evaluating his progress (price: 10 cents).

All are available as separate items or will be furnished with each purchase of the basic reference manual, *A Professional Guide for Young Engineers*. The guide includes "The Second Mile" papers of William E. Wickenden, Canons of Ethics for Engineers, and the Faith of the Engineer. Total cost of the Guide and brochures is $1.00. All are available from ECPD, 29 West 39th Street, New York 18, N. Y.

1959 Nuclear Congress Draws Civil Engineers to Cleveland

The attention of civil engineers was attracted during the 1959 Nuclear Congress by several subjects of direct and special concern to them. These were waste disposal, water supply, and site evaluation. Such papers, and the resulting discussions, emphasized the growing concern of civil engineers for the part they must play in the rapidly developing atomic power industry.

The 1959 Nuclear Congress, held in the Public Auditorium in Cleveland, April 6 through 10, was actually a coincidence of several different meetings: the Fifth Nuclear Engineering and Science Conference, the Atomic Energy Management Conference, the Seventh Hot Laboratories and Equipment Conference, the Atomfair, and a meeting of the Nuclear Energy Writers' Association. ASCE was a sponsor of and participant in the Nuclear Engineering and Science Conference.

The extensive program, which brought together the interests of many disciplines —engineers, physicists, chemists and mathematicians, for instance—was designed for exchange of information in the various professional fields. The civil engineering parts of the program were arranged through the efforts of James G. Terrill, Jr., the ASCE program representative, and presided over by ASCE Members Conrad Straub and Wendell R. LaDue.

Waste Disposal Discussed

Radioactive waste disposal has posed a major obstruction to the development of nuclear plants. The experience obtained in several installations was discussed during the Cleveland Congress. A comparison of the design considerations and performance results of the radioactive waste disposal plant at Shippingport was presented by J. R. Lapointe, W. J. Hahn, and E. D. Harward. Their paper reported that operation difficulties encountered have resulted in redesign of portions of the system. The new design was discussed.

The disposal of reactor waste into underground salt cavities was described by Shosei Serate and E. F. Gloyna, A.M. ASCE, the University of Texas. This paper gave new insight into the stress redistribution around the underground cavities, as functions of the cavity depth and strength of salt in physiochemical effects of the waste on the walls of the cavity.

Disposal of radioactive waste from nuclear power ships has been studied to some extent. The result of these studies was presented to the Congress by James M. Smith, Jr. Such studies indicated that it would be possible to effect safe and economic release of such wastes directly to sea, with reasonable limitations near land. In streams, however, the situation is quite different, as discussed by R. F. Foster, who expressed the need for biological monitoring of radioactive wastes in streams, with the particular concentration of certain isotopes.

Contamination of Water Supplies

That it will be necessary to develop some emergency procedures in case of accidental release of liquid radioactive waste from a nuclear reactor into a source of water supply was suggested by Ernest D. Harward, J.M. ASCE, of the U.S. Public Health Service. Several technical approaches useful in developing emergency procedures were suggested. This was related to a paper by Gerhard Klein, who has been making studies on the potability of water following a nuclear attack. As Dr. Klein pointed out, the uncertainties of pre-attack estimates of radiological concentrations have made necessary the establishment of certain basic concepts in the formulation of emergency criteria for drinking water and in the development of new avenues of approach.

Water supply is one of the factors receiving continued study in site selection for nuclear projects. An evaluation study was given by G. R. Hagee, B. Branson, A. S. Goldin, G. J. Karches and C. P. Straub, A.M. ASCE, all of the Robert A. Taft Sanitary Engineering Center in Cincinnati.

The major address at the All-Congress Banquet was presented by Herbert F. York, Director of Research and Engineering of the U.S. Department of Defense. Dr. York presented a very interesting account of the relationship between nuclear energy and the activities of the space agency in the recent Project Argus. This nuclear fission project, in space, has presented scientists with much new information that is currently being studied.

Inquiries regarding papers, and orders for such papers, should be sent to the American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. ASME was the manager for the 1959 Congress.

ASCE Will Manage 1960 Congress

It is anticipated that the program for the 1960 Nuclear Congress, to be held in New York City, April 4 through 8, will feature a program of considerable value to civil engineers. For this congress, ASCE has been invited to serve as the managing society. The Coliseum, in New York, will be the site for this large-scale operation. Twenty-seven engineering and scientific organizations participate in the congress, which is coordinated by the Engineers Joint Council.

A Step Toward Unity

As a step toward unity of the engineering profession, the American Society of Mechanical Engineers announces that in the future members of twenty-one sister engineering societies will be welcome to attend general meetings of ASME without paying a registration fee. At conferences sponsored by any of ASME's Professional Divisions, they will pay the same fee charged ASME members, usually one-half of the non-member rate. The twenty-one groups are those represented on Engineers Joint Council or Engineers Council for Professional Development.

ASCE Protests Fee Limitation in Bill

ASCE is protesting an engineering fee limitation proviso in a Department of the Interior appropriations bill, HR 5915. The limitation, not heretofore carried in any appropriation bill, provides in SEC. 401 "Not to exceed 5 per centum of the cost of any project constructed under the appropriations contained in this Act may be expended for engineering and design of the project." This bill does not cover Bureau of Reclamation projects.

The bill is before the Senate Committee on Appropriations. In the name of the American Society of Civil Engineers, Executive Secretary Wisely has wired a protest against this provision to Senator Carl Hayden, chairman of the Senate Appropriations Committee.

New Edition of "Who's Who in Engineering"

The 1959 edition of *Who's Who in Engineering*, a comprehensive biographical reference on the nation's leading engineers, has just been published. About 18,000 engineers are covered in this eighth edition. The volume also includes a directory of engineering and engineering-connected groups at both state and national level, and alphabetical and geographical indexes. The reference is designed to serve a wide area, not only of the engineering profession but also of individuals and organizations connected with engineering.

Who's Who in Engineering is published by the Lewis Historical Publishing Company, Inc., 265 West 14th Street, New York 11, N. Y.

EJC Directory of Engineering Societies

Publication of the 1959 Engineering Societies Directory—the most comprehensive in the United States and the first since June 1956—is announced by Engineers Joint Council. The Directory provides basic information on international, national, regional, state, and local engineering groups. It also includes the address of the society, the secretary, the membership, and publications relating to the organization. In addition, it gives information on the structure of Engineers Joint Council, and includes Canons of Ethics for Engineers and the Faith of the Engineer.

The Directory sells for $3.50, and is available from Engineers Joint Council, 29 West 39th Street, New York 18, N. Y.

Early Transactions Volumes Obtainable

The feasibility of reproducing the first ten volumes of ASCE TRANSACTIONS (1872-1881) has been studied. It has been decided that these historic volumes could be reproduced at a cost that would permit a top price of $150 for the ten-volume set. If more than 100 engineers, or libraries, indicate an interest in obtaining such a set, the project will be undertaken. If the endeavor is successful, other rare volumes of TRANSACTIONS will be reprinted.

Engineers interested in obtaining the ten-volume set should write to the Executive Secretary of ASCE, 33 West 39th Street, New York 18, N. Y.

EJC Establishes Transportation Panel

As a first step toward recommending a national transportation policy, Engineers Joint Council has established an eighteen-man panel to study existing difficulties and explore broad principles of coordinating the nation's major fields of transportation. In recognition of the need for such a policy, EJC President Enoch R. Needles recently called a meeting of representatives of all major fields of transportation, including railways, airways, highways, pipelines, and waterways, to discuss possible action.

The panel set up at the meeting has voted to explore the situation and determine how EJC might best assist in formulating a transportation policy. Mr. Needles was elected temporary chairman of the panel.

Newly formed Water Resources Coordinating Committee meets with Technical Division representatives. Chairman Finley B. Laverty (third from left, seated) receives suggestion from Col. L. B. Feagin (left), chairman of Waterways and Harbors Division. Also shown are Members George J. Vencill and Richard R. Kennedy (seated) and Don P. Reynolds, William W. Donnan, and Maurice L. Dickinson (standing).

Coordinating Committee in Water Resources Field

The widespread concern for the water resources of our nation is shared by ASCE members in many specialty fields. Five of the Technical Divisions devote much of their effort to development, utilization, and conservation of water. In recent months attention has been given to better coordination of such efforts of our membership, as it serves on committees, in arranging conferences and convention sessions, and in the publication of vital information.

The ASCE Board of Direction has created the Water Resources Coordinating Committee. In operation since the first of the year, this small but representative group of members is striving to assure complete coverage of the areas of civil engineering concern in water resources, to minimize duplication of activities, to stimulate more effective cooperation with other professional groups in the same field, and to enhance the opportunity for civil engineers to become even more effective in solving major water resources problems.

Current efforts of the Coordinating Committee are directed toward improved structure of the several Technical Divisions. Effective communication with the Divisions is assured by overlaping membership, with Division Executive Committee members serving as representatives of their Divisions on the Coordinating Committee. The results will be reported to the membership.

ASCE Sponsors Exchange of U.S. and Russian Engineers

An exchange of United States and Russian soil mechanics and foundation engineers has been arranged for this summer. Co-sponsors of the exchange are ASCE, the Highway Research Board, and the U. S. National Council on Soil Mechanics and Foundation Engineering.

Arriving in the United States on May 31, the Russian engineers will take part in four regional seminars, to be held at Princeton University, Massachusetts Institute of Technology, the University of Illinois, and the University of California (Berkeley campus). The local committee chairmen responsible for arrangement of the seminars are Professors G. P. Tschebotarioff, T. W. Lambe, R. B. Peck, and H. B. Seed. Visits to New York, Washington, Chicago, and the AASHO Test Road at Ottawa, Ill., have also been arranged. ASCE members interested in participating in the regional seminars may contact the local chairmen directly.

The return visit of the U.S. delegation is tentatively scheduled for late August or early September.

Division Doings

Irrigation and Drainage Division

A joint conference of the American Meteorological Society and the ASCE Irrigation and Drainage Division is set for August 27-29 at the Albany Hotel, Denver, Colo. Its theme will be the particularly timely subject of "Weather Modification by Artificial Means." All the speakers are nationally known authorities in the field, which assures a worthwhile program.

Engineers are urged to bring their families and enjoy Colorado's "Rush to the Rockies" Centennial Celebration, which will be in full swing at the time of the conference. This celebration will recall the 1859 mining boom when rich gold and silver lodes were discovered in the Rockies.

General conference chairmen are N. A. Christensen, Director, School of Civil Engineering, Cornell University, and Robert D. Elliott, President, North American Weather Consultants. Local chairman is Robert L. Mueller, Armco Drainage and Metal Products, Inc., Denver, Colo.

Highway Division

Testing of materials is done by established laboratories, but there is a gap between the experienced materials engineer's knowledge and that of relatively inexperienced engineers, especially the young men just out of college. To bridge this gap data on the significance of tests for highway materials have been assembled in Proceedings Paper No. 1385, which is part of the Journal of the Highway Division, Vol. 83, No. HW 4, September 1957. This paper contains discussions of what are considered to be basic tests in the areas of Soils, Bituminous Materials, and Concrete and Concrete Aggregates. Each discussion was reviewed by a great many practicing highway engineers, and appropriate changes were made in the discussions. The paper was prepared by the Highway Division's Committee on Significant Tests for Highway Materials.

Experienced engineers will find little new in Paper No. 1385, but it can serve as a readily available reference and as substantiating evidence when decisions must be made on reports submitted by the materials engineer to the executives.

The committee is interested in knowing how the material already prepared is used. Should it complete the discussion of the basic tests in the remaining highway materials areas? Should it continue by providing discussions on the less common but usually accepted tests and, finally, by discussing the not usually accepted and uncommon tests? An indication of the extent of use of Paper No. 1385 would help the committee in its decision. Comments should be sent to Prof. Taylor D. Lewis, School of Civil Engineering, Cornell University, Ithaca, N. Y.

Structural Division Organizes New Committees

A new Committee on Buildings is being organized within the Structural Division, with the overall aim of advancing the profession of structural engineering in the building field. Specifically, the Committee will: (1) Make recommendations leading to improved relationships between the engineer and others who participate in design and construction in the building field; (2) review and correlate technical problems in the building field, for the purpose of recommending action and study by the committee or in cooperation with other ASCE committees; and (3) encourage the dissemination of knowledge in the building field.

In addition to the administrative committee, under Chairman Roy Johnston, three tentative task committees are being formed. These are on Interprofessional Responsibilities, with Al Miller chairman; Structural Design Methods, with Milo S. Ketchum chairman; and the Study of Specifications and Building Costs, with Charles Yoder serving as chairman.

Of special interest to structural engineers will be a Symposium on Plastic Design in Steel, to be held at Queen's University, Kingston, Ontario, June 15-19. Dr. M. R. Horne, of Cambridge University, will be the leading speaker. Subjects covered will range from fundamental concepts to economics and general status, with examples from both Britain and the United States. Inquiries about the Symposium may be addressed to Dr. H. W. Curran, Director of Extension, Queen's University, Kingston, Ontario, Canada.

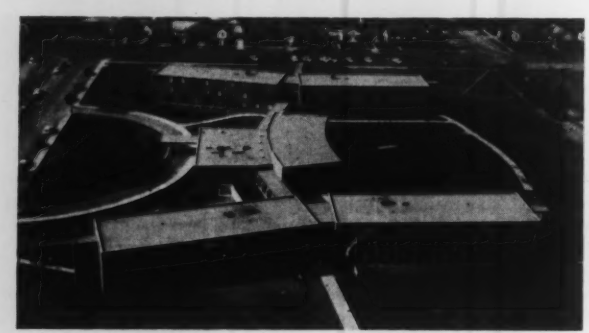
Soil Mechanics and Foundations Division

The Soil Mechanics and Foundations Division is making it possible for members to participate more actively in international soils activities through cooperation of the Division with the United States National Council on Soil Mechanics and Foundation Engineering. The Division is setting up a roster that will amplify the list of members formerly enrolled in the U.S. National Council.

All members currently listed with the U.S. National Council will automatically be included in the new roster. Other members of ASCE who wish to be included in this roster, as well as on the roster of the Soil Mechanics and Foundation Division, may do so by sending their name, position, firm or organization, and mailing address to Mr. John Lowe, III, Secretary for International Activities, Soil Mechanics and Foundations Division, 62 West 47th Street, New York 36, N. Y.

Among the advantages of being listed on the proposed roster are the receipt of information on international conferences, and the privilege of purchasing at discount some of the publications of the International Society, and the other national societies of that organization.

The Soil Mechanics and Foundations Division has arranged this change-over to simplify administrative matters, and to provide broader representation of United States engineers in the activities of the International Society. The aim of the International Society is the promotion of international cooperation among scientists and engineers in the field by sponsoring international conferences; by creating permanent research committees; by publishing a biennial list of members; and by promoting the publication of abstracts.



Green Hall, one of the new dormitories on Colorado State University campus—headquarters for the Hydraulics Conference, July 1-3—is shown here. The Conference Program is in this issue (page 70).

The Younger Viewpoint

Committee on Junior Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

Zone I	Zone II	Zone III	Zone IV
Louis K. Walter, Jr. 320 Market Street Kenilworth, N. J.	Albert C. Nelson 250 N.E. 51st Street Miami, Fla.	Walter D. Linzing 4751 No. Paulina Chicago 40, Ill.	Rodney P. Lundin 9744 Quakertown Ave. Chatsworth, Calif.

Salary expected? How often have you stumbled over this question on employment application forms? Many of us have encountered it several times, and on each occasion it arouses doubt and uncertainty.

C A. Rambow, J.M. ASCE, of the University of Wisconsin, has put his thoughts on paper. He writes us as follows:

"I would like to throw out a question for the "Younger Viewpoint," and hope to get some opinions from readers of CIVIL ENGINEERING.

"The problem is this: what does one do with the question, "Salary expected," or something of the sort, which frequently appears on employment application forms. My most recent clash with this was with a state government, which wrote back after I had answered the question with the word "open," and specifically requested the minimum salary I would accept.

"If a person names a figure, does this violate Section 4 of the Code of Ethics?

"How can an employer expect a reasonable answer from a person who knows nothing of the nature, location, or even the existence of the position for which he is applying? What do employers want this information for, if they use it for purposes other than that of choosing the applicant on a price basis?

"I don't recall seeing any discussion on this in recent years, but if ASCE has any policy in the matter I would certainly like to know about it."

This is an interesting point and one that nearly all of us have faced at some time. Your comment will be helpful.

Computer Talk

Word length—fixed or floating point—data cards—input—arithmetic unit—these and other terms in "computer talk" are becoming familiar words to a group of civil engineers in Washington, D. C. As a service to ASCE members in the area, the National Capital Section Junior Member Forum is sponsoring a course in electronic computers. Entitled "Using Electronic Computers in Civil Engineering," the course will emphasize the training of the civil engineer in the capabilities of small computers. Since many agencies and consulting firms have access to computers, the course will be valuable to the participating engineers by supplying them with the background needed for distinguishing which of their problems can profitably be solved with the aid of a computer.

Included in the course will be details on costs and economics of computers. Of particular interest to the Washington engineers will be information on the rental of computer time on an hourly basis in the D. C. area.

Practical work sessions with the computers are a feature of the twelve-session course. Several companies have made available their computers, and sessions will be conducted in the various offices in the downtown Washington area. Instructors for the sessions will be prominent local computer experts.

Another service to younger members is being offered by the Metropolitan Section Junior Member Forum. A review course for Part III of the New York State Professional Engineering License Examinations is being sponsored by the Forum's Education Committee.

Offering valuable assistance to candidates for the P. E. license, the review course will feature brush-up work on engineering economics and structural engineering. Also included in the thirty-hour course will be review sessions on engineering ethics, surveying, hydraulic engineering, fluid mechanics, and sanitary engineering. Instructors for the course will be men with teaching and engineering experience, well qualified to present their respective topics.

It is hoped that these two projects will stimulate interest among other Junior Members to develop similar programs throughout the country.

United Engineering Center

Soon, a monument to the entire profession of engineering will rise on United Nations Plaza in New York City. The United Engineering Center, the new home for the Five Founder Societies as well as several other engineering societies, will be an 18-story building across from the United Nations Park.

Among the Five Founder Societies, ASCE ranks fourth in the percentage of goal pledged, with $340,000 still to go. Here is an opportunity for younger members to get in and push. An offer to help will get you acquainted with those on committees in your Local Section. Perhaps you can call on engineers on an informal basis rather than as a job seeker or a salesman. You may make some new friends—and you will really be helping toward a United Engineering Center, of which you can be proud for all your professional life.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.13	1.22
Baltimore	1.12	1.11
Boston	1.18	1.15
Chicago	1.36	1.30
Denver	1.21	1.20
Houston	1.26	1.12
Kansas City	1.11	1.14
Los Angeles	1.21	1.21
Miami	1.57	1.57
New Orleans	1.03	1.21
New York	1.25	1.21
Pittsburgh	0.95	1.05
Portland (Ore.)	1.16	1.11
San Francisco	1.24	1.19
Seattle	1.06	1.06

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	0.92	0.89
II, Mid. Atlantic	1.13	1.17
III, Mid. West	1.16	1.25
IV, South	1.08	1.10
V, West	1.02	1.02
VI, Far West	1.11	1.15

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current salary total for ASCE Grades I, II and III by an arbitrary base. The base is $15,930. This is the total of salaries paid in 1956 for the equivalent Federal Grades GS5, GS7 and GS9. Only the annual base entrance salaries are used in these calculations. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was January 31, 1959.

ASCE Membership as of April 9, 1959

Members	10,440
Associate Members	14,856
Junior Members	17,152
Affiliates	83
Honorary Members	43
Total	42,574
(April 9, 1958	40,763)

1959 Washington Award Goes to James R. Killian

James R. Killian, Jr., President Eisenhower's first Special Assistant for Science and Technology, is 1959 winner of the Washington Award. The award is being presented to Dr. Killian at a dinner sponsored by the Washington Award Commission in Chicago on April 13. He will be the featured dinner speaker.

Dr. Killian was president of Massachusetts Institute of Technology from 1949 to 1958, when he was called to Washington to accept the newly created post in the President's Cabinet. The citation accompanying his award reads, "For exceptional leadership and achievement in scientific and technological education and distinguished service to his country and mankind."

The Washington Award is conferred on the recommendation of the Washington Award Commission, representing the four Founder Societies and the Western Society of Engineers. It was established and is administered by the Western Society of Engineers.

Film Sought for Movie On Civil Engineering

A task committee appointed by the Board of Direction last October is seeking color film footage that can be adapted to the production of an ASCE motion picture on the theme, "The Civil Engineer at Work," for use in public relations and in engineering education.

Working with a modest appropriation from the Voluntary Fund, the committee, headed by former Director R. Robinson Rowe, states that it will welcome contribution or loan of appropriate color film on civil engineering projects from which sequences could be copied and supplemented with some new film for continuity of the completed picture. Contributed film would be filed and catalogued in the Society's library; borrowed film would be returned uncut after partial copying. Other members of the committee are Director John E. Rinne and former Director Robert H. Sherlock.

The program was authorized on a trial basis, with a series implied if the first is successful—all to be appropriately titled to the theme. The first will cover the broad field of civil engineering generally, while later releases may be more specialized. All will contemplate projection on television, before civic and fraternal groups, and to students interested in civil engineering as a career.

Specifically, film is wanted in every major field of civil engineering, particularly planning, design, construction, operation and maintenance aspects. Atomic energy plants and missile stations will be included as well as the more traditional civil engineering fields. Preference will be shown for takes at instructive, critical, or dramatic stages, particular if engineers are shown, or if their direct connection with the scene can be expressed on the sound track.

The ASCE film, as edited and released, will give full credit for all film used, whether contributed or borrowed. Films for the project should be shipped directly to the chairman, R. Robinson Rowe, 2701 Third Ave., Sacramento 18, Calif., with full and definite instructions on (1) authorship or ownership to be credited in title frames, (2) permission to copy and use selected sequences, and (3) address and deadline for return of loan film.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1960 contest closes May, 1, 1960. See 1959 Official Register, page 143.*
FREEMAN FELLOWSHIP:	*1960-61 (closing date pending). See Official Register, page 154.*
ERNEST E. HOWARD AWARD:	*1960 award closes Feb. 1, 1960. See Official Register, page 142.*
ASCE RESEARCH FELLOWSHIP:	*1960 award closes March 15, 1960. See Official Register, page 156.*

Engineering Societies Personnel Service Elects Officers

The San Francisco Advisory Committee of ESPS named officers for its 33rd year, from representatives appointed by the local sections of the Founder Societies, at a recent meeting attended by Ernest O. Kirkendall, national president of ESPS, and H. Newell Appleton, national director. Shown here (left to right, seated) are L. A. Norman, representing AIME (resigning); Dr. Kirkendall, executive secretary of AIME; Ben L. Raffin, vice-chairman of ESPS, representing ASCE; Mr. Appleton, assistant secretary of AIME; and Richard M. Stewart, treasurer, ESPS, representing AIME. Standing are J. R. Decker, Western representative of ESPS; Charles K. Lewis, assistant treasurer, ESPS, representing San Francisco Engineers Club; Eric Salo, secretary, ESPS, representing ASME; Martin W. McLaren, assistant secretary, ESPS, representing AIEE; Harvey N. Skow, representing AIEE (resigned); A. B. Sabin, consultant, guest; and Newton D. Cook, manager, ESPS.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Jerry S. Dobrovolny, associate professor of general engineering at the University of Illinois, spoke on "The Impact of Engineering on the Civil War" at the **Central Illinois Section's** March meeting. Professor Dobrovolny became interested in the subject when appointed to a committee to investigate the feasibility of a course for non-engineers in the philosophy of engineering. Although the course met with something less than eager acceptance by non-engineers, there was so much interest among engineering students that there are now four classes in the subject.

The **Lehigh Valley Section** held its annual joint dinner meeting with the Lehigh Valley section of the American Welding Society on March 2. Carl L. Kreidler, chief engineer of Lehigh Structural Steel Company, Allentown, Pa., discussed the fabrication and erection of the steelwork for Pan American's new $8,000,000 passenger terminal now being built at N. Y. International Airport to accommodate jet plane traffic. Attorney William B. Joachim, Jr., member of Bethlehem's newly formed Charter Commission Study Group, gave a short talk on the citizen's responsibility in present-day politics. He invited engineering sections to participate more actively in local government.

The **Vermont Branch** of the **Maine Section** held its first meeting of the new year recently. Those attending heard a panel discussion on "The Engineer as a Professional Man—Vermont Registration." The panel consisted of Stephen Knight, moderator; Prof. Walter D. Emerson, secretary of the Vermont Board of Engineer Registration; Prof. Clarence J. Douglas, Department of Civil Engineering at Norwich University; Dr. Elmer Munger, Department of Civil Engineering at Norwich University; and Robert D. Patterson, of the Vermont Structural Steel Corporation. A lively discussion period followed.

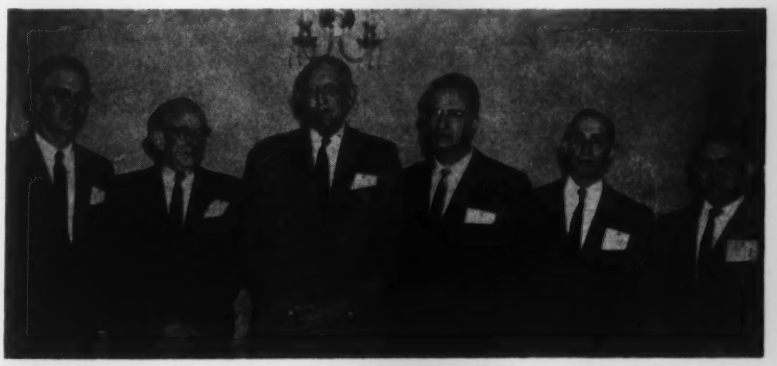
A recent meeting of the **Maryland Section** heard E. A. Carlson, of the Chesapeake & Potomac Telephone Company of Maryland, report on construction of the distant early warning, radar network in the Arctic Circle. It was followed by an illustrative film. The film, a documentary relating the hazards and hardships encountered in the construction of the huge project along the Arctic frontier, brought home to the members the magnitude and importance of the work.

Elsie Eaves, the first woman member of ASCE, addressed the annual dinner of the **Metropolitan Section** at the Tavern-on-the-Green in Central Park, March 16. Miss Eaves, as manager of the Business News Department of *Construction Daily, Engineering News-Record,* and *Construction Methods and Equipment,* runs the largest research and statistical department in industrial journalism. In her talk she told how both history and today's technology encourage the entry of women into engineering. Statistics cited by Miss Eaves indicated that this is true throughout the world, especially in Russia, where 29 percent of professional engineers are women and 40 percent of technicians are women. The currently projected Narrows Bridge was the topic at the annual dinner meeting of the Section's **Junior Member Forum.** Addressing the 150 engineers present, Edward Alcott, executive director of port development for the Port of New York Authority, discussed the planning of the $320 million project. The bridge will connect Brooklyn and Staten Island, serving as a bypass south of Manhattan. Engineering problems involved in the design of the bridge, which will have the world's longest span (4,260 ft), were discussed by Milton Brumer, partner in Ammann and Whitney. The bridge will have two levels with a total of twelve vehicular lanes.

Col. Charles B. Schweizer, district engineer of the St. Louis District, U. S. Army Corps of Engineers, moderated a panel discussion on the $133,000,000 St. Louis Flood Protection Project at the March meeting of the St. Louis Section. He was introduced by Henry S. Miller (right), president of the St. Louis Section. The panel included E. E. Bloss, Elmer E. Schake, M. F. Lamm, Frank Kriz, and W. Q. Kehr.

At its first meeting of the season, on March 3, the **Mexico Section** held installation exercises for its 1959 officers. They are Miguel Montes de Oca, president; Gustavo L. Ramirez, vice president; and Humberto J. Benet, secretary-treasurer. Later, Guillermo Salazar Polanco showed colored slides made during a recent visit to USSR and Europe.

At a recent meeting, the **Oregon Section** awarded H. Loren Thompson, partner in the Portland firm of Stevens and Thompson Engineers, a gift in absentia for his expert handling of the Society's 1958 Convention at Portland. Al Skelton, division engineer in the Oregon State Highway Department, received a Life Membership Certificate. In the featured talk Dr. Donald Pickering of the University of Oregon's Medical School,



Life memberships were presented at the March meeting of the Kansas City Section to R. C. Gibson, C. Kelsey Mathews and Bert R. Mullen. The life members and their sponsors are, left to right, Roy F. Warner, R. C. Gibson, C. Kelsey Mathews, Russell G. Kincaid, Bert R. Mullen, and Roy G. Schwamb.

Prominent engineers at the all-day annual conference of the New England Council, held at the University of Connecticut on April 4, were (left to right) Ayres C. Seaman, Connecticut Section president; Ernest A. Dockstader, Massachusetts Section president; Dean Weston S. Evans, District 2 Director; and Executive Secretary William H. Wisely, guest speaker at the luncheon meeting. Other featured speakers included William S. Wise, director of the Connecticut Water Resources Commission; William G. Shannon, Soil Conservation Service; Prof. T. William Lambe, Massachusetts Institute of Technology; J. Burch McMorran, superintendent of Public Works for New York State; and Norris C. Andrews, of the New Haven City Plan Commission. The Connecticut Section was host.

Follow-up to the Spring meeting of the San Francisco Section's Construction Division, held on March 19, was a field trip to the stadium site of the new home of the San Francisco Giants (in background). Guide for the 60 members and guests was J. P. Silvestri (in foreground), of Charles L. Harney Inc., the general contractor. Architect John Bolles was featured speaker at the dinner preceding the tour.

Philadelphia Section engineers turned out for the regular March meeting to hear C. Roger Denison (center), coordinator of research for the Maritime Commission of the Department of Commerce, speak on "The Need for Port Development and Desirable Objectives." Flanking Mr. Denison, from left to right, are Commissioner Thomas C. Brown, director of port operations for the City of Philadelphia; Brig. Gen. J. Alex Crothers, director of port development for the Delaware River Port Authority; Robert L. Taylor, president of the Port of Philadelphia Maritime Society; and Maj. Gen. H. B. Vaughan, Jr., president of the Section.

pointed out the need for additional legislation and support in "matching" funds for further development of the Medical School. At the recent annual banquet of the Oregon State College Student Chapter, Dr. John Swarthout, dean of faculty at Portland State College and former professor of political science at Oregon State College, spoke on the problems involved in establishing a sound foreign policy.

March 24 was Civil Engineering Day in the year-long program of community activities celebrating Pittsburgh's 200th Anniversary. Special afternoon and evening meetings—at which both the President, Francis S. Friel, and Executive Secretary, William H. Wisely, of ASCE spoke—were sponsored jointly by the **Pittsburgh Section** of ASCE and the Pittsburgh Bicentennial Association. At the afternoon session, a group of 400 Pittsburgh area high school students, chosen carefully for their interest in science and engineering subjects, heard Mr. Wisely speak on the subject of civil engineering as a career. Touching on some of the major projects of the civil engineer, such as dams, bridges, highways and buildings, Mr. Wisely said that many of the works of the civil engineer do not seem spectacular, but nevertheless take on the proportions of miracles—water today is mankind's cheapest commodity, about five cents per ton. In the evening Francis S. Friel delivered a public address on the role of the military and civil engineer in the development of Pittsburgh. He said that many cities today are experiencing the pangs of too-rapid development, resulting in the traffic situation, which he called "the greatest domestic problem with which we are faced." In closing he urged more intensive study of public transit as a solution.

Following a tradition of long-standing, the technical program at the annual meeting of the **St. Louis Section** was sponsored by the Student Chapter at Washington University. It included the presentation of Student Awards and a talk, illustrated with movies and slides

BETTER BEDS FOR OUR BOMBERS WITH dart

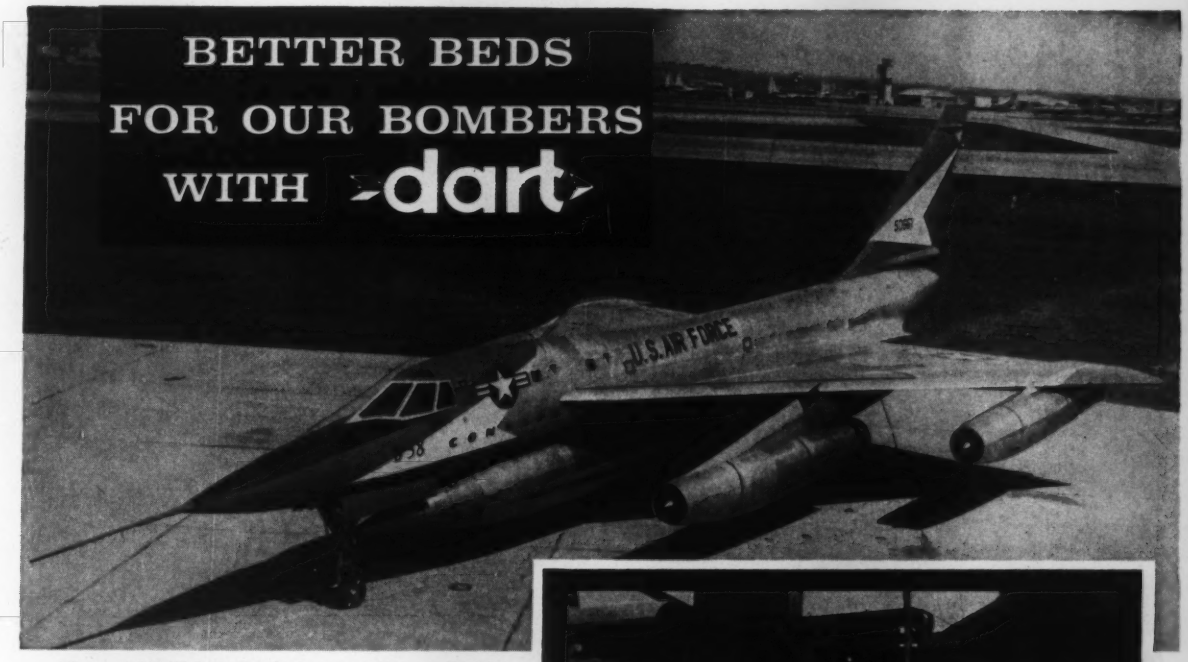


Photo of USAF B-58 Bomber courtesy Convair Division, General Dynamics Corp., Ft. Worth, Texas

When a jet pilot touches his bird down on a bed, it means that he has landed tons of high speed aircraft on a concrete runway — a runway which must withstand tremendous forces and weight repeatedly for today's flying requirements.

These runways *must* have high quality, well consolidated concrete. Dart's screed battery of high-cycle vibrators with in-head motors offers contractors the means to produce the quality concrete to meet these demanding specifications . . . and with less manpower, less time lost, lower costs and greater performance than ever before made possible.

FOR EXAMPLE: Dart's last screed job for a SAC runway extension used 13 Model DHC-100 high-cycle vibrators hooked into a 15 KW generator. This vibrator battery, operating over a 25′ width and consolidating concrete with a minus 1½″ slump, 34″ depth and a 2½″ aggregate, handled all the concrete 2 mixers and the spreader could produce on deep bed and very low slump.

Specify DART on your next large highway, dam, runway or launching pad job. Write for details or see your nearest DART distributor. There are 87 authorized DART sales and service branches in the U.S.A.

Four Reasons to Specify Dart Vibrators:

1 In heavy pours, high-cycle vibrators *must* be removed from concrete while motor is running. DART's DHC-100 high cycle vibrators *eliminate* burn-out problems common to most other vibrators. Dart units may be removed without the concrete acting as a coolant.

2 Easy to service. DART's high-cycle vibrators have a complete removable motor section assembly, taken off and replaced in minutes. Only the motor section need be carried as a service item and is easily carried in a service kit.

3 Versatile, DART high-cycle vibrators may be used in either screed battery for wide pours or may be detached and used conventionally merely by adding additional lengths of pre-loaded handling hose and switch.

4 Complementing "pan" vibration, the DART high-cycle vibrators may be installed at rail or form at each side to produce quality consolidation. Easily powered by one small 3 KW 180 cycle generator.

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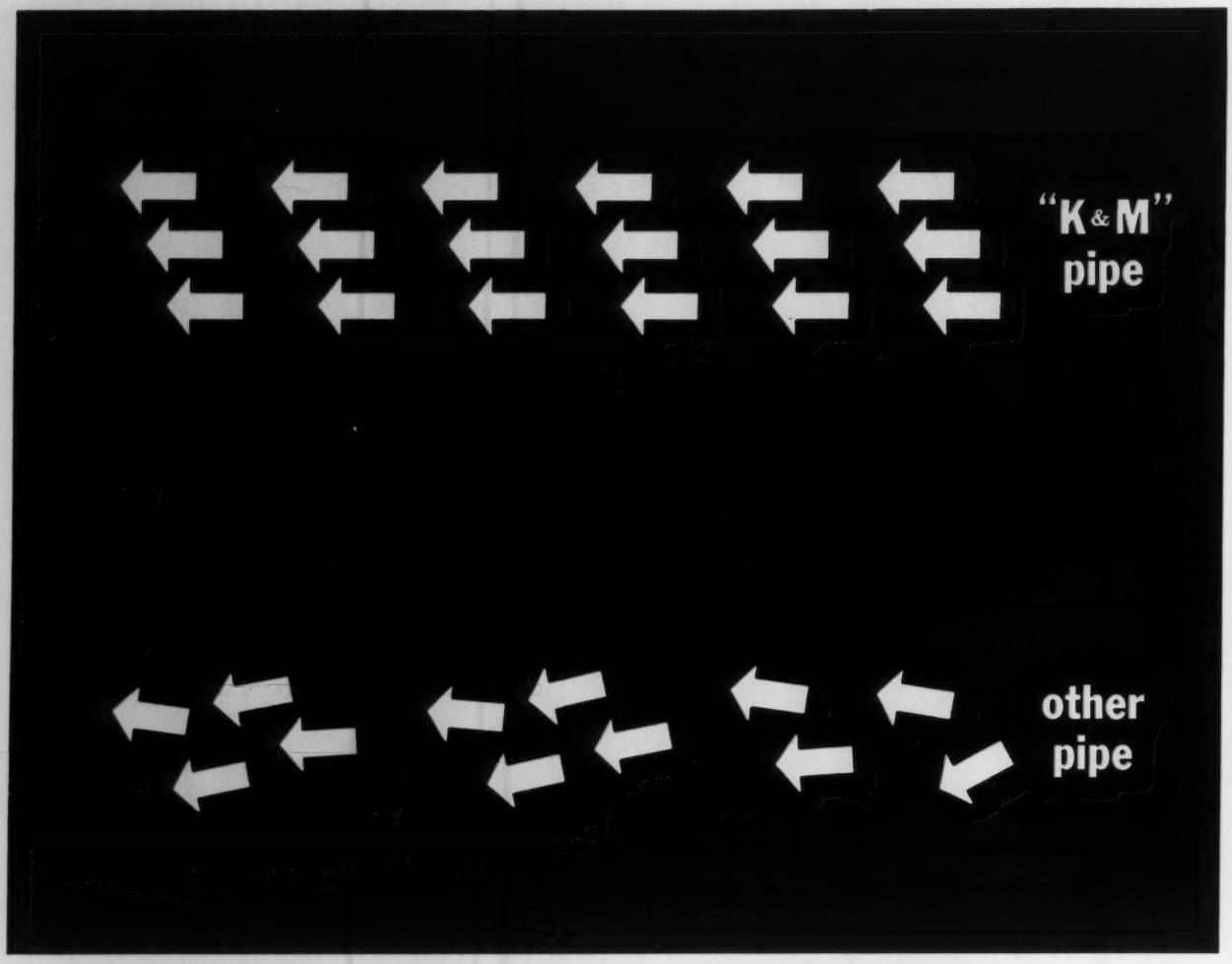

Maintenance is practically zero! "K&M" Asbestos-Cement Pressure Pipe is non-electrolytic, non-tuberculating, and corrosion-resistant. Pumping costs remain constant. Never increase with the age of "K&M" Asbestos-Cement Pressure Pipe.

Connections are permanent and water-tight. The FLUID-TITE Coupling gaskets grow tighter as pressure climbs. As water mains fill, the self-energized rubber gaskets expand.

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Rex M. Whitton (right), chief engineer of the Missouri State Highway Department, inspects model of the new civil engineering building at the Missouri School of Mines. With him are Prof. E. W. Carlton, and Troy Roberts, president, ASCE Student Chapter.

Officers of the newly established Cape Canaveral Branch of the Florida Section are, pictured in usual order: F. R. Heartz, treasurer; M. L. Uitti, president; and H. G. Leistner, secretary. Vice president R. M. Tanner is not shown.

of the $22,000,000 AASHO Road Test at Ottawa, Ill., under the direction of the Highway Research Board. The speaker, Frank Scrivner, is research engineer for the project.

The **Southern Idaho Section** presented ASCE Life Membership Certificates to two eminent Idaho Engineers at a recent meeting: William P. Hughes, retiring urban engineer for the State Highway Department and Robert F. Hamilton, former assistant state engineer. The meeting featured an illustrated program on Spillway Design Floods, given by the Section's Junior Members. Horace Titus was elected second vice-president, replacing K. Brimhall who has moved to Utah.

A talk on the problems of the metropolitan Milwaukee area was given by Charles Ball, at a recent meeting of the **Wisconsin Section**. Mr. Ball is technical director of the Metropolitan Study Commission, which at present is studying the problems caused by the changing forms of the area. Their aim is to suggest legislation to the state on the various aspects of metropolitan government. New Wisconsin Section officers are: Willard W. Warzyn, president; Henry B. Wildschut, first vice president; Edward A. Korpady, second vice president; Donald D. Roethig, secretary-treasurer.

ASCE CONVENTIONS

ANNUAL CONVENTION

Washington, D. C.
Hotel Statler
October 19-23, 1959

NEW ORLEANS CONVENTION

New Orleans, La.
Jung Hotel
March 7-11, 1960

RENO CONVENTION

Reno, Nev.
June 20-24, 1960

TECHNICAL DIVISION MEETINGS

JET AIRPORT CONFERENCE

Houston, Tex.
Shamrock-Hilton Hotel
May 20-22, 1959

Sponsored by
ASCE Air Transport Division
Houston Branch of
Texas Section

HYDRAULICS CONFERENCE

Fort Collins, Colo.
Colorado State University
July 1-3, 1959

Sponsored by
ASCE Hydraulics Division
Colorado Section
Colorado State University

IRRIGATION AND DRAINAGE CONFERENCE

Denver, Colo.
Albany Hotel
August 27-29,1959

Sponsored by
Irrigation and Drainage Division
American Meteorological Society

LOCAL SECTION MEETINGS

Cleveland—Dinner meeting at Fenn College, May 16, at 6:30 p.m.

Illinois—Weekly luncheon meetings at the Engineers' Club, Chicago, every Friday at 12 noon.

Metropolitan—Meeting in the Engineering Societies Building, May 20, at 7 p.m.; dinner meeting of the Junior Member Forum in the Engineering Societies Building, May 13, at 7 p.m.

Texas—Regular meeting of the Austin Branch at the Austin Engineers and Associates Club the third Thursday of each month, at 7 p.m.; meeting of the Dallas Branch at the Hotel Adolphus the first Monday of each month, at 12:15 p.m.; meeting of the Fort Worth Branch at the Hilton Hotel the second Monday of each month, at 12:15 p.m.

Virginia—Norfolk Branch meeting at the YMCA Cafeteria the third Monday of each month, at 12 noon; Richmond Branch meeting at the Hot Shoppe Cafeteria the first Monday of each month at 12:15 p.m.; Roanoke Branch meeting in the S & W Cafeteria the second Wednesday of each month, at 6:30 p.m.

Wisconsin—Regular meeting in the library of the ESM Building, June 8, at 7:30 p.m.

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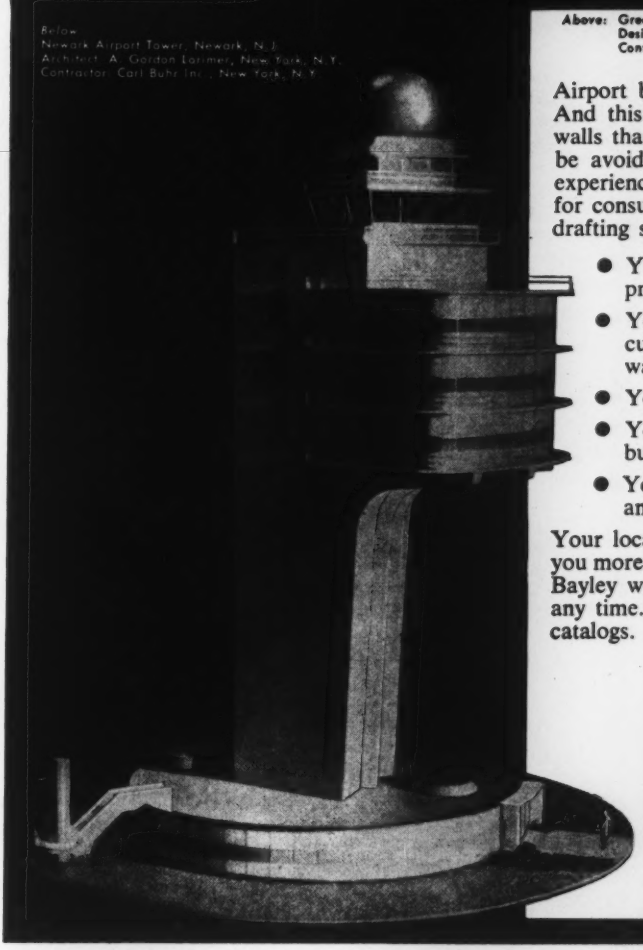
Above: Greater Pittsburgh Airport, Allegheny City, Pa.
Designer: Joseph Hoover and Allegheny Dept. of Aviation
Contractor: Dick Construction Co., Pittsburgh, Pa.



Below
Newark Airport Tower, Newark, N.J.
Architect: A. Gordon Lorimer, New York, N.Y.
Contractor: Carl Buhr Inc., New York, N.Y.

Airport buildings present their own special problems. And this applies equally to the windows and curtain-walls that figure in the project. But such problems can be avoided by making full use of Bayley's extensive experience in this class of work — by calling Bayley in for consultation while your project is still in the rough drafting stages. By doing so —

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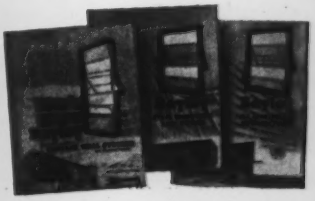
Write today for your personal copies of these three catalogs: **Steel Windows, Aluminum Windows and Aluminum and Steel Curtain-Walls.** See them also in Sweet's Architectural and Industrial Construction Files.



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BY-LINE WASHINGTON . . .

Uncle Sam is becoming a more active competitor for engineering personnel, even though he's already the world's largest employer of engineers and scientists. And there's ample evidence that engineers are looking with more favor on government employment. The all-agency Conference on Scientific Manpower in Washington at the end of April was one evidence of increased recruiting activity. It brought educators, government officials, representatives of industry together for a two-day discussion on the care and handling of technically trained people.

Other moves include a 10 percent general pay increase for white-collar workers last June; continuation of existing special pay rates—above base rates—for shortage-category positions; authorization for agencies to hire top college graduates at higher grades; authorization to pay travel and moving expenses for new employees in shortage categories; a series of special examinations aimed at recruiting 200 top-grade young engineers for careers in research.

Add to all that the appeal by several governmental branches—notably the Defense Department—asking Congress to create further "supergrades" (carrying salaries ranging from $14,190 to $17,500, and a few up to $19,000) for scientific and engineering people.

The basis for the government's optimism is a Civil Service Commission study of recruitment, which showed that the percentage of acceptance of job offers for beginning professional grades jumped from 17 percent in 1954 to 40 percent in 1958—against an industry rate of 46 percent.

One slightly sad commentary on all this: Because recruiting is going so well, CSC has advised all federal agencies that it will make no changes in existing adjusted pay rates for shortage-category engineering jobs.

* * *

How much traffic could a city street carry, if all conditions were ideal? The Bureau of Public Roads has decided to find out and, incidentally, put a lot of its bright young engineers to work on an interesting project. A team of them has been assigned to study the Capital's Wisconsin Avenue (one of the main arteries to the north), to develop facts on what could be done, if every known means of expediting traffic flow were used. Results aren't expected for about six months.

* * *

Look for injunctive action on the President's recent order drastically curtailing import of oil from abroad. One fear is that the order may increase costs of asphalt in the U. S. The problem is not one of shortage—there's plenty of the heavy crudes used for asphalt production available in the U. S. But higher U. S. production costs could up the price. Injunctive action, however, would come from some major oil companies that have gambled heavily on imported crudes—principally from South America.

Congress has shown no disposition to hurry in solving the financial problems of the Interstate Highway system. But you can make two safe bets:

- The program won't be held up.
- Congress will find the needed money by borrowing, not by raising taxes, as has been proposed by the Administration.

Proposals for rises in gasoline and diesel fuel taxes have raised a storm of protest, both from user groups and from the states themselves, which look on further federal taxes in this area as an encroachment on their own revenue sources. The answer will be some form of borrowing—most probably from the general fund, with security in the form of notes on the trust fund, for the future.

Meanwhile. there have been some evidences of attempts to solve other highway problems—but on the fringe of the money problem. One of these is a series of measures in both houses to increase from five to seven years the time allowed between taking land for highways and actual start of construction. Another group of bills seeks to incorporate the Bureau of Public Roads' 1958 cost estimates (which show a 37 percent rise over 1956) as the basis for making future allocations.

* * *

Bill HR 1, providing for additional diversion of water from Lake Michigan at Chicago, was promptly referred to the Senate table. Chances are good it will die there quietly, despite the fact that the House practically shouted it through. The measure would provide for an additional diversion of 3,600 cfs at Chicago, to help out the Sanitary District by increasing flows toward the Mississippi.

The Canadian Government, most of the Lake states, and nearly every Lake city registered protests. It is feared that the diversion would lower Lake levels, thus endangering navigation and port facilities (including the St. Lawrence Seaway), as well as water intakes and sanitary sewer outfalls.

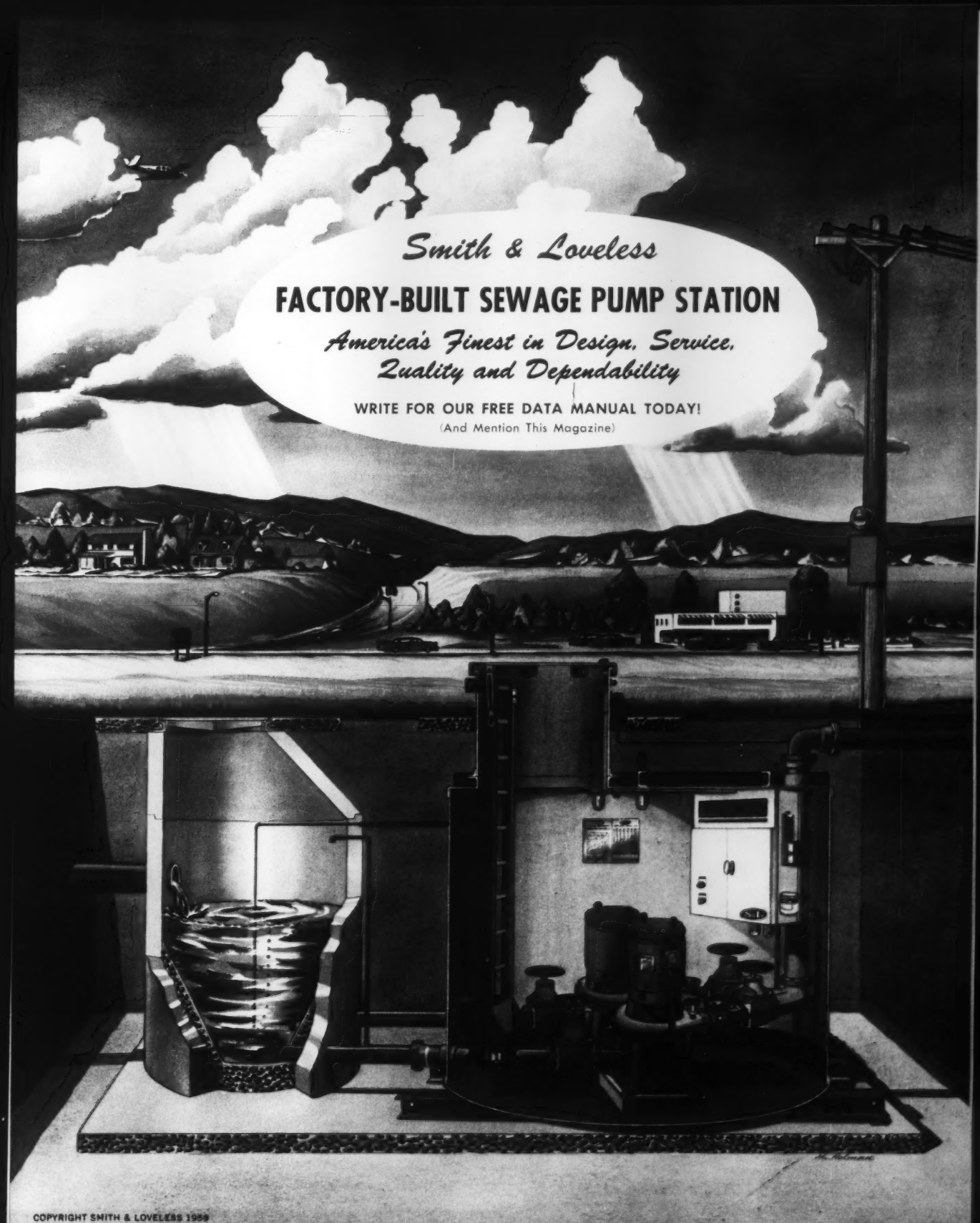
* * *

Three tax measures now in the hoppers will affect engineers either as self-employers or employees.

Hottest of these is Senate Joint Resolution 67, on which hearings began in mid-April. This would limit the powers of states to tax salaries and wages of out-of-state residents.

Another is HR 10, which went through the House late in March. It would permit self-employed persons to exempt as much as $2,500 a year from taxable income, if the money was paid into a bona-fide retirement program. Don't count the money yet—the Treasury has already complained the bill could cost something like $365 million a year in revenues.

The third is a new one (S 1097), which would halt Social Security taxes on employees who have reached the age of 65. Arguments for it: At that age, employees receive no further benefits in the form of added payments; employers would save some bookkeeping, and payments into the fund (which this year run to $120 a year for employees making $4,800 a year or more).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Now, at a cost significantly below that of any similar equipment, Bendix provides a complete computing system with 100 card per minute punched card input and output, and 100 line per minute tabulation.

Heart of the system is the Bendix G-15 general purpose digital computer, which has proven its performance in well over 150 successful installations.

The CA-2 coupler, a newly developed G-15 accessory, enables the computer to operate in conjunction with conventional punched card and tabulating equipment.

A full 80 columns of numeric, alphabetic, or special character information can be accommodated using only the CA-2 as a connecting link between the card equipment and the G-15. Any column of the card can contain any one of the three types of information.

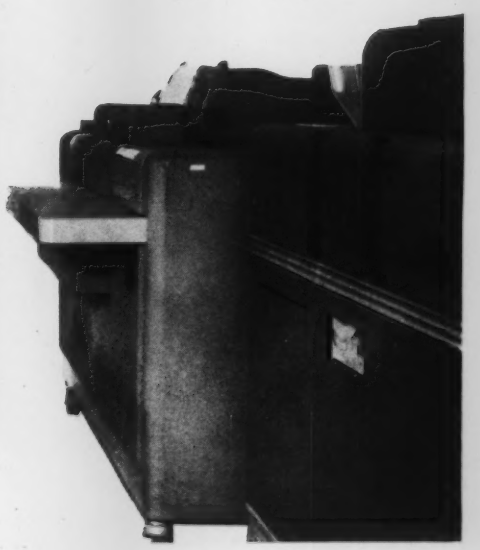
Three input-output units may be connected simultaneously . . . one for input, one for output, and a third for input or output. Data may be read or punched by standard card units, or printed by standard tabulators. All input and output is under complete control of the computer. Computation can proceed during the input or output cycle, thus assuring maximum over-all computing speed.

In addition to the CA-2, the computer's typewriter and paper tape equipment, and auxiliary magnetic tape storage units may be used for completely versatile input, output, and storage. Both power and space requirements of the complete punched card computer system are approximately half that of other systems of this type.

A system that includes the G-15 computer, the CA-2 coupler, two summary punches and a tabulator, leases for approximately half the price of a typical medium-priced system with similar capabilities.

Whether you are now using punched card or computing equipment, or if you are delaying such plans due to high costs, you will want to learn more about this inexpensive, efficient equipment. Detailed technical information on the G-15 and the CA-2 will be sent on request. Write to the Bendix Computer Division of Bendix Aviation Corporation, Los Angeles 45, California. **Department** P-11.

Bendix Computer



NEWS BRIEFS . . .

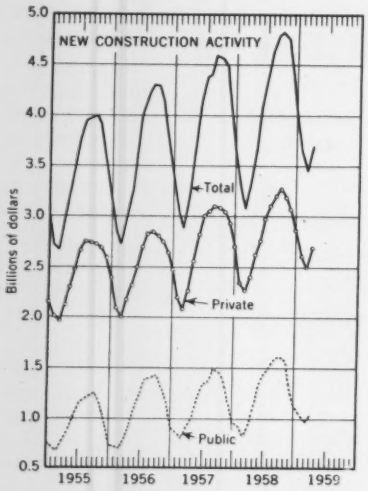
First-Quarter Construction Sets New Record

The dollar volume of new construction put in place in March rose seasonally, bringing the total for the first quarter of 1959 to a record $10.9 billion—12 percent more than in the same period of 1958—according to preliminary joint estimates of the U. S. Departments of Commerce and Labor.

The latest quarterly figures reflect a 10 percent rise in private construction from the first quarter of 1958, paced by a 32 percent increase in new housing outlays. The expansion in residential construction, plus scattered gains in other private types of work, more than offset the continued weakness in office and industrial building.

In the public sector, most types of construction shared in the 12 percent advance this year over the first quarter of 1958. Activity was off slightly for educational building and water projects.

These monthly estimates are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. Except when special surveys are made, the estimates do not reflect the effects of varying numbers of working days in different months, or of special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements.



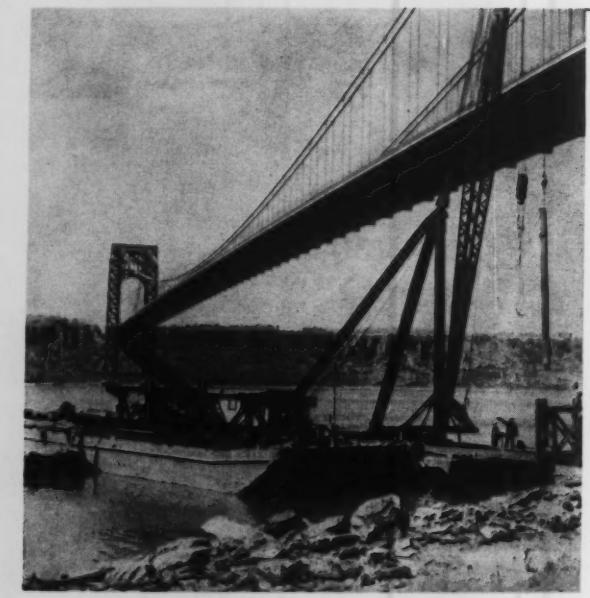
Seasonal rise in construction activity in March brings first-quarter total to $10.9 billion—12 percent above first quarter of 1958.

Research Program on Weather Modification

A $1,130,000 research program in weather modification is announced by Dr. Alan T. Waterman, director of the National Science Foundation. The program, to be carried out in fiscal 1959, consists of thirteen grants for laboratory research, field experiments, evaluation of present theory and practices, and conferences on modern meteorological methods directed toward weather modification. All grants for the current year have been approved.

The National Science Foundation was authorized to provide for the present program by Public Law 510 (85th Congress). The program was established in July 1958. In the laboratory, tests will be made to determine the most efficient freezing nuclei. The field work will include cloud-seeding experiments, using silver iodide and other agents, to find out more about cloud formation and the precipitation process. Other means of modifying clouds and weather will include the introduction of layers of lamp black and similar heat-absorption agents to change artificially the radiation balance of clouds and induce local changes in atmospheric electricity.

Conferences will be conducted by the American Geophysical Union, the National Research Council, and the Foundation for Instrumentation Education and Research.



Lower Deck for George Washington Bridge to Be Built from River

New six-lane lower deck for the George Washington Bridge will be built upward to avoid interfering with traffic. Work started March 23 when Bethlehem Steel erection crews began pile-driving operations on the New York side. The piles will form a dock for the mooring of steel-carrying carfloats. Part of the 13,640 tons of steel required for this addition to the world's third longest suspension span will be unloaded at the dock and assembled. Erection plan calls for lifting material from the ground assembly area up to the bridge for construction of the side span extending from the shore to the tower on the New York side. A similar operation will take place on the New Jersey side. For construction of the span between towers, material will be lifted from barges anchored in the river. O. H. Ammann, Hon. M. ASCE, designer of the George Washington Bridge, is consultant to the Port of New York Authority on design of the second deck. Completion of the lower deck is set for December 1960.

Airstrip Paving Materials

The House Armed Services Special Investigating Subcommittee became concerned with the exclusion of materials other than concrete for airstrip runways and commenced an inquiry in February 1954. The subcommittee, headed by F. Edward Hebert, reported to the Committee on Air Services, of which Carl Vinson is chairman.

From this investigation has come a change in procedure, including asking for alternate bids where asphalt might be acceptable and economical. In 1957 the committee endorsed a proposal of the Army Corps of Engineers and the Air Force, with full information to the industry, for a test on construction criteria for asphalt runway pavement, which could meet the "new requirements" of the Air Force. The test was concluded in November 1958.

The conclusions of the Corps of Engineers, U.S. Army, were presented by Maj. Gen. Walter K. Wilson, Jr., and Brig. Gen. Edward A. Brown, his deputy. The conclusions and recommendations are as follows:

1. Considering normal B-52 operations only, we have concluded that the tests at Columbus Air Force Base demonstrated the validity of the design and construction procedures developed by the Corps of Engineers for heavy-load flexible runway interior pavements.

2. Runway pavements must, however, be capable of supporting incidental periods of B-52 taxi operation in addition to the normal landing and takeoff traffic. The tests indicated that objectionable differential settlement could possibly develop on runways where taxi operations are extended over a period of six months or longer.

3. The flexible-pavement surface in the immediate vicinity of the buried-slab transition between the flexible and rigid pavement sections developed a ⅝-in. depression across the width of the traffic test lane.

4. An average 1¼-in. subsidence of the flexible pavement in the traffic lane, combined with a peculiarity of the test traffic pattern, resulted in excessive differential settlement between the trafficked area and the non-trafficked area to either side. The abrupt change in surface elevation would not be expected under normal B-52 operations but would be a possibility under extended taxi operations.

5. The surface smoothness within the traffic lane itself after completion of the test complied essentially with the smoothness tolerance allowed during the construction.

6. The Corps of Engineers feels that the pavements were designed and constructed under as representative conditions as possible, considering the unusually large number of sidewalk superintendents from both Government and industry.

7. The test was not intended to show an economic comparison between rigid and flexible pavement. Any such comparison based upon experience at Columbus Air Force Base would have little world-wide application. Local conditions will determine the economics.

8. The test was conceived and planned to establish the capability of flexible runway interior pavements only. The Corps of Engineers has not altered its position that primary taxiways and runway ends on heavy-load airfields should be constructed of rigid pavement except in exceptional geographic areas.

9. The Corps of Engineers has concluded that it is possible to construct heavy-load flexible runway interior pavement that will provide adequate service for normal B-52 operations. However, B-52 operational conditions may occur that could cause objectionable roughness in flexible pavement because of differential settlement. Therefore, as a general policy, we are in agreement with the Air Force that a center strip of rigid pavement in runway interiors is good insurance.

The Air Force concurred in the Corps of Engineers report. Commenting on taxiing on runways, John M. Ferry, Special Assistant for Installations, USAF, remarked on the alert procedures for fully loaded aircraft, which require simulated takeoffs at frequent intervals. The aircraft is taxied down a runway subjecting it to the loading characteristics on taxiways.

Mr. Ferry called attention to the fact that each B-52 has a value of $7,100,000, not counting the payload, and a weight of 500,000 lb which must be accelerated to 170 mph to reach takeoff speed. On rough or uneven pavement surfaces precision instruments are jolted, and oscillations set up in the aircraft result in a changing distribution between the front and rear gears. And aircraft are sometimes pitched into the air before gaining sufficient flying speed.

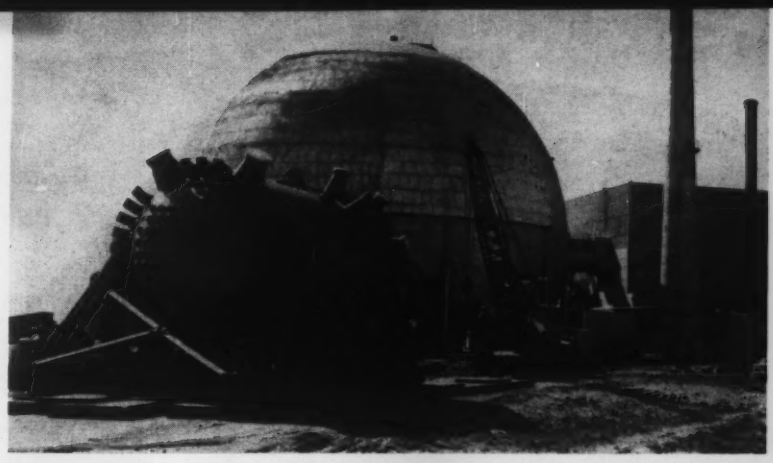
Mr. Ferry concluded "it is the Air Force position that all portland cement concrete runways are preferable for the reasons stated but where a substantial economy is possible by using a combination of rigid and flexible paving it is a reasonable decision to build a center strip of portland cement concrete pavement between the concrete ends, with asphaltic concrete pavement on both sides."

The special subcommittee has recommended:

1. That the Department of the Air Force, the Corps of Engineers, U.S. Army, and, where affected thereby, the Department of the Navy, accept, adopt, and implement the engineering conclusions made by the Corps of Engineers and presented to this subcommittee on December 2, 1958.

2. That the Department of the Air Force and Corps of Engineers or Navy Department, when acting for the Department of the Air Force or on its own account, specify as an alternate in all future bids, not only portland cement but asphaltic concrete of the design and on the criteria of December 2, 1958.

3. That the Navy Department immediately coordinate its studies and research with that of the Department of the Air Force and the Corps of Engineers, U.S. Army.



Largest Nuclear Reactor Installed in Dresden Plant

Largest nuclear power reactor ever built is ready for installation in the Commonwealth Edison Company's Dresden Nuclear Power Station near Morris, Ill. The 300-ton reactor is in position here to be placed in its 190-ft steel containment sphere. Built by the New York Shipbuilding Corporation, the massive unit was shipped by barge from Camden, N. J., over a circuitous 3,600-mile route. The reactor vessel has 5½-in.-thick walls, consisting of low carbon steel with ⅜-in interior stainless steel lining. The Dresden Station is expected to be ready for regular service in mid-1960. General Electric is building the plant for a contract price of $45,000,000. Commonwealth Edison, which will own and operate the station, is paying $30,000,000 of the contract price. The balance will be paid as a research and development expense by the co-sponsoring Nuclear Power Group.

Girders for Umbrella Roof of Pan American Terminal

Two 100-ton cranes jockey into position a 76-ton girder—one of 32 that will serve as "ribs" for the world's largest steel umbrella. The umbrella, which will be as big as the Yankee Stadium, forms the roof of the new passenger terminal being fabricated and erected by the Lehigh Structural Steel Company for Pan American World Airways at New York International Airport. The girders vary in length from 186 to 224 ft and in weight from 61 to 76 tons. Each was shop assembled into three shipping pieces, which were welded together on arrival at the airfield.

Dutch Present Plan for Reclaiming Jersey Meadows

Dutch experts hired to study the feasibility of reclaiming the Jersey Meadows have presented a plan that would put 15,000 acres of the Hackensack Meadows in condition for development. The key feature in the plan is a dam to be built near the mouth of the Hackensack River from Kearny to Secaucus. A lock would keep the river open to navigation, and a sluice in the dam would maintain stream level. An incidental but important benefit of the project would be elimination of the breeding place of the notorious Jersey mosquitoes by creating a fresh water lake in place of the present sluggish tidal stream.

The proposed dam would be 1,050 ft long flanked by dikes on both sides. Earthen levees would also be built along the banks of the stream for a distance of 8½ miles. Five pumping stations would be required to drain the protected lands, though the water table would be near the surface. The reclaimed land would have a firm clay base suitable for most uses.

This plan would call for an initial investment of $15,000,000, covering the dam, sluice gate, and navigation locks. It does not include fill. The plan was presented by Peter Westbroek, one of the directors of Netherlands Engineering Consultants, an independent Dutch engineering organization. The Dutch firm, known as Nedeco, was retained by the Meadowlands Regional Planning Board several months ago to study the feasibility of controlling tidal action by engineering works at the mouth of the Hackensack River.

The Passaic Valley Citizens Association —a non-profit organization devoted to the balanced development of the Passaic area —recently completed its second report to the Meadowlands Regional Planning Board in a Master Plan Series devoted to reclamation plans. The report is the first of two making up the second phase of the study. The second part of the report sets forth the group's recommendations on land use and a major road plan. This study, under the general direction of Ernest Erber, executive director of the Passaic Valley Citizens Planning Association, was carried out by a specially assembled project staff. Ralph M. Field was supervising project planner, and the consultants were Joseph S. Ward, A.M. ASCE; Peter D. G. Hamilton, M. ASCE; and Joseph M. DeSalvo, J.M. ASCE.

The reports of the Passaic Valley Citizens Planning Association and NEDECO come to different conclusions, since each was commissioned to present a plan for a different area of the work. The Citizens Planning Association was asked only to develop a reclamation plan for the five-town area, while NEDECO was directly commissioned to devise a plan for the closure of the Hackensack River, which would reclaim about 15,000 acres to the north of this closure. It has been suggested that the Citizens Plan for the smaller area may ultimately be incorporated into the more comprehensive plan developed by NEDECO.

International Course in Hydraulic Engineering

The third International Course in Hydraulic Engineering will be held at Delft, the Netherlands, from October 21, 1959, to September 9, 1960. This course is organized by the Technological University at Delft in cooperation with the Netherlands Universities Foundation for International Cooperation. It is intended for graduates in civil and hydraulic engineering, preferably those with some practical experience. English is the language of instruction.

The program permits the following choice of courses: (1) Tidal and Coastal Engineering, including harbors; (2) Rivers and Navigation Works (including groundwater recovery); and (3) Reclamation. The course comprises lectures, group discussions, working visits, and a period of practical work, adapted to the special needs of the student with a view to future work in his own country. Diplomas in hydraulic engineering will be awarded upon satisfactory completion of the course.

Interested engineers are invited to apply to the Netherlands Universities Foundation for International Cooperation, 27 Molenstraat, The Hague, Netherlands.

Six-Mile Breakwater Planned for Nigeria

A $21,000,000 contract to build a six-mile breakwater into the Atlantic Ocean off Nigeria, Africa, is announced by Raymond International Inc. The contract has been awarded by the Government of Nigeria to a joint venture of Richard Costain and Raymond International (U.K.), Ltd., London, a subsidiary of Raymond International Inc. Work will begin this spring.

Called the Escravos Bar Mole, the 29,650-ft rockfill breakwater will be built into the sea at the mouth of the Escravos River. Its purpose is to prevent drifting sands on the ocean floor from blocking the offshore channel leading to the Escravos estuary, gateway to a number of up-river ports. When the new breakwater is completed, this offshore channel will be dredged, permitting ships of 20-ft draft to enter the deep-water rivers and creeks beyond the estuary. About 1,250,000 cu yd of quarried rock, ranging in size up to 10 tons, will be required to build the breakwater.

Chicago May Unite Its Rail Terminals

Chicago is finally giving serious consideration to the long-discussed problem of consolidating its rail terminals now scattered all over the city. A municipal body called the Railway Terminal Authority has submitted to the city and the railroads a $158,000,000 plan to raze four terminals south of the Loop and consolidate them in Union Station, Chicago's newest terminal, which was built in 1925. Union Station, which is on the west bank of the Chicago River between Adams Street and Jackson Boulevard, would be taken over by the Authority and enlarged to accommodate the new facilities.

The terminals that would be eliminated are the Central Station, used by the Illinois Central and the Big Four railroads; the Dearborn Station, used by the Santa Fe, the Chicago & Eastern Illinois, Erie, Grand Trunk, and Wabash and Western Indiana; the LaSalle Street Station, used by the New York Central, the Nickel Plate, and the Rock Island; and Grand Central Station, used by the Baltimore & Ohio, the Chesapeake & Ohio, and the Soo Line. The Illinois Central's commuter terminal, on the east side of the Loop, would not be affected. Nor would the plan involve the Chicago & Northwestern Station north of the Loop. The present Union Station accommodates the Burlington, Pennsylvania, Milwaukee, and Gulf, Mobile & Ohio.

This newest plan for terminal consolidation will be decided by the nineteen trunkline railroads affected. Fifteen of them must favor the plan if it is to be put into effect. It is expected that reaching an agreement may require a year, and that construction would probably take five years more. In the past the railroads have rejected plans for consolidation. However, it is believed that in view of the steady decline of through passenger trains in the past fifteen years and the operating economies offered by the plan, the railroads will find the idea of consolidation more attractive this time. The city hopes to persuade the University of Illinois, which must leave its Navy Pier campus, to relocate its Chicago campus south of the Loop on land now owned by the railroads.

Contract Let for ICBM Facilities

Award of a $12,870,000 contract to the Malan Construction Corporation, of New York City, for construction of basic facilities to support an Atlas Intercontinental Ballistics Missile base in the Omaha area has been announced by the Omaha District office of the Corps of Engineers. The ICBM facilities, which are being built by the Corps of Engineers for the U. S. Air Force, will be located near Missouri Valley, Iowa; Arlington, Nebr.; and at the Mead Ordnance plant west of Omaha. The project, which must be completed within 390 days, includes nine launch and service buildings, three launch operations buildings, and three power and pump houses.

Water Pollution Control Division Formed in PHS

The status of water pollution control activities in the Public Health Service has been raised by Arthur S. Flemming, Secretary of Health Education and Welfare, who has approved the creation of a Division of Water Pollution Control. During the past two years water pollution control activities have been carried out in the Water Supply and Water Pollution Control Branch of the Division of Sanitary Engineering Services. Gordon E. McCallum, M. ASCE, chief of the Water Supply and Water Pollution Branch, will be in charge of the new division.

In an additional action to strengthen pollution control activities, Secretary Flemming has approved the recommendation of the Surgeon General for establishing the position of Associate Chief for Sanitary Engineering of the Bureau of State Services. This position will be filled later.

Compressed Air Used for De-Icing Waterways

A major new blow in man's war against weather has been struck at Thule, a U. S. Arctic defense post on the west coast of Greenland, less than 800 miles from the North Pole. The test campaign, waged by a joint task force of U. S. and Canadian naval personnel and engineers, helped keep the Thule port open to shipping some forty days past normal closing time last fall. Further operation of the Thule experiment—code named "Polynya" from the Russian word for an open body of water surrounded by ice—holds promise of extending the annual shipping season longer than ever before and of starting it weeks earlier than in the past.

Arctic waters off Thule are normally open to shipping only about three months of the year. While powerful icebreakers can lead supply ships into port, the hundreds of tons of broken ice frequently damage ships' plates—expensive to repair or replace—and cause heavy damage to the pier itself. To extend the open season, Rear Admiral Donald T. Eller, commander of the Atlantic area of the U. S. Military Sea Transportation Service, enlisted a de-icing system developed by Atlas Copco.

The de-icing system, which has been in successful use in Scandinavian waters for several years, consists of anchoring compressed air lines beneath the surface. As soon as ice begins to form in the fall, compressors are placed in operation. Tiny holes drilled in the submerged lines cause new circulation currents, which bring to the surface heat from the warmer bottom depths and prevent the formation of ice. In salt water the dense saline solution brought to the surface was found to be almost as effective as warm water in preventing the formation of ice. The system has been in use on Sweden's great Lake Malar, in parts of the St. Lawrence River, and on Great Bear Lake in the Northwest Territory of Canada.

USNS Mirlak is shown in ice-free mooring slip at Thule, Greenland. Bubbles (shown surfacing in open water area at right) from compressed air lines laid at predetermined depths alongside Thule's DeLong Pier carry dense saline solutions to the surface and prevent ice formation in the treated area.

Long-Span Steel Arch Railroad Bridge for Pakistan

New railroad bridge over the Rohri Channel of the Indus River, near Sukkur, West Pakistan, will be the ninth longest steel arch in the world, when it is completed early in 1961. It will be a steel trussed arch with span of 806 ft 9 in. and total height of 204 ft. The project will replace a cantilever structure, the 70-year-old Landsdowne Bridge, which is now restricted to the lightest locomotives and speeds of 5 mph. The new bridge will carry one broad-gauge track, plus a 15-ft-wide concrete deck, for emergency use by military vehicles. D. B. Steinman, M. ASCE, is consulting engineer on the project for the Government of Pakistan.

March Sets Record For Steel Output

Steel production in March set a record for the month, with steelmaking furnaces pouring 11,567,000 tons of ingots and steel for castings, according to a preliminary report of the American Iron and Steel Institute. This record March production represented an increase of 1.9 million tons over February production and of 5.3 million tons above the March 1958 output. Only two previous months have had outputs in excess of 11 million tons—October 1956 (11,048,513 tons) and January 1957 (11,008,762 tons).

Total production for the first quarter of 1959 was 30,487,323 tons, the highest output since the first quarter of 1957 when the figure was 31,585,042 tons. In the first quarter of 1958 the output was only 18,790,857 tons.

Based on the nation's rated steelmaking capacity of 147,633,670 tons (as of January 1, 1959), the nation's steelmaking facilities were utilized at an average of 92.3 percent of capacity this past March, in comparison with 84.8 percent in February. In the first quarter of 1959 facilities were utilized at 83.7 percent of capacity.

Rapid Transit System For San Francisco Area

Directors of the five-county San Francisco Bay Area Rapid Transit District have adopted a crash program of engineering studies aimed at early completion of plans for a 123-mile regional rapid transit system serving the five central counties of the Bay area. The detailed studies will start with an investigation of every form of public transportation—supported, suspended, etc.—as the method adopted is basic to the rest of the study. Advance research will also be required to determine the most efficient and economical means of propulsion, including the possibility of using atomic power. Negotiations are currently underway with both engineering and financial consulting firms.

The program was unanimously adopted at a recent board meeting on the recommendation of Keneth M. Hoover, chief engineer of the Transit District. John M. Peirce is general manager of the district.

Steel Shipments Up in February

February shipments of steel products direct from the mills totaled 6,524,374 tons, an increase of 5.5 percent over the January total, despite the fact that January was three days longer. Still more encouraging, shipments this February represented an increase of 2,261,000 tons over February 1958 shipments.

The major markets for finished steel products during February were the automotive (1,494,440 net tons); warehouses and distributors (1,161,842 net tons); and construction, including maintenance (769,827 net tons).

New Bridge Over Soo Canal Planned

Engineering recommendations for a long-discussed bridge to connect the United States and Canada (Michigan and Ontario) at Sault Ste. Marie have been prepared by D. B. Steinman, M.ASCE, New York City consulting engineer. The proposal is being studied by Michigan and Ontario highway officials and the International Bridge Authority, a body created by the State of Michigan.

The plan calls for a two-lane, 12,000-ft-long structure (counting approaches) with 2-ft emergency walkways on both sides. The river spans carrying the roadway over the American and Canadian ship canals would total 4,810 ft in length. The approaches on the American side would cover 4,165 ft, and on the Canadian side 3,045 ft. The crossing would require 67 piers, to be founded in sandstone rock. Maximum water depth is 20 ft. The bridge would cost $18,198,000, and require eighteen months for construction.

The report considered the possible alternative of a 4,805-ft tunnel in making the international traffic connection. The cost of such a tunnel was estimated at $27,500,000, and construction time was put at thirty-six months.

Navy to Have World's Largest Radio Telescope

Structural steel fabrication for the world's largest radio telescope started early in April at the Roanoke, Va., plant of the American Bridge Division of the U.S. Steel Corporation. The major feature in a new Naval Radio Research Station, the huge project will be built on a 1,500-acre site in a mountain area near Sugar Grove, W. Va. With it the U.S. Naval Research Laboratory will conduct studies in radio astronomy and research in radio communication.

According to a Navy spokesman, the powerful telescope "will add greatly to man's knowledge of the far reaches of outer space, looking out into the universe an estimated 38 billion light years." It will be capable of "seeing" and "hearing" certain types of objects nineteen times as far out as does the 200-in. optical telescope at Mount Palomar, Calif. A 60-ft pilot model will be erected this spring in advance of actual construction. This unit is being fabricated by the Kennedy Company, Cohasset, Mass.

The radio telescope will require in excess of 20,000 tons of steel, and will cost over $60,000,000. It was designed by U.S. Navy engineers. The prime contract has been awarded to a joint-venture group, consisting of the Tidewater Construction Corporation, Norfolk, Va.; Peter Kiewit Sons Company, Omaha, Nebr.; and Patterson-Emerson and Comstock, Pittsburgh, Pa. The Nello L. Teer Company, of Durham, N. C., has been clearing and grading the construction site, which is nearly ready. The entire project is scheduled for completion in 1962.

N. G. Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

When Guest Professor Kum Pewter was being reintroduced to wind up his magic cubes, alias the sink strainer, alias the perfect star, Joe Kerr was already at the blackboard, writing:

$A+C+J+O = 27$ $A+I+J+K = 27$
$A+E+K+L = 27$ $B+I+J+O = 27$
$B+D+N+O = 27$ $C+I+N+O = 27$
$B+F+J+K = 27$ $D+I+M+N = 27$
$C+E+M+N = 27$ $E+I+L+M = 27$
$D+F+L+M = 27$ $F+I+K+L = 27$
$A+B+C+D+E+F+I+J+K+L+M+N+O = 91$

Answer: $I = 10$, etc.

"Why," asked Professor Pewter, "the 'etc.'?"

"Well," explained Joe, "with 13 equations in 13 unknowns, I just fed the matrix into our hightronic computer with Program K98K9 and it hummed away and started answering with I=10. Then it revved up to a whine, rang a gong, and went phhfffttttt. When the man brings a new fuse in the morning, I'll find 'etc.'."

"Unnh-uh," predicted Cal Klater. "You have only 10 *independent* equations, so your matrix spawned null determinants and hightronic ran away dividing 0/0. Order it to solve in terms of J, L and N and it would report:

$A = 10+N-J$ $D = 10+J-N$
$B = 10+L-J$ $E = 10+J-L$
$C = 10+L-N$ $F = 10+N-L$
$K = 7-N$ $M = 7-J$ $O = 7-L$

Now it is evident that opposite apices add to 20 and opposites in the corona add to 7. Pairs of the latter must be $1+6$; $2+5$; $3+4$. Because of rotational freedom, we can locate one pair arbitrarily, say $K = 1$ and $N = 6$, so that

$A = 16-J$, $C = 4+L$, $D = 4+J$, $F = 16-L$

Then the remaining pairs can be assigned semi-arbitrarily because of freedom in reflection, that is, J,M equals 2,5 or 5,2 and L,0 equals 3,4 or 4,3. Since the difference between J and L can't exceed 2, B and E can't be less than 8. The only spots for 7 are C and D, so L=3 is the only basic solution and the rest of the numbers fall into place like this:

F	13
$A\ K\ L\ E$	11 1 3 12
$J\ I\ M$	5 10 2
$B\ O\ N\ D$	8 4 6 9
C	7

QED."

"That's my boy," yelled the Guest Professor. "Altho it can be rotated and reflected 12 ways, there's only one perfect star adding to 27. Spot the 13 numbers in reverse order and you have a perfect star adding to 29."

"Thanks, Kum, for a star performance," applauded Professor Neare. "Now to change the subject quickly to predecessors of bridge engineers, you may be surprised to learn that travelers came from great distances to admire the rope ferries of the ancient Djins and wonder at the skill of the Djineros who built them with such precision. 'En-Djineria' became a watchword for such marvels, and tho the secret of the builders was buried with them, the phrase survives in the modern name 'engineer' for the wonder builder. Fortunately one traveler recorded the dimensions of the small ferry at Djindjin River, where a 70-ft rope hung from a high limb to the water's edge. Back from the river in another tree was a platform 32 ft high, so located that a Djin could haul the end of the rope to the brink of the platform, then swing on it over the river, and drop exactly at the far bank. How wide might the river have been?"

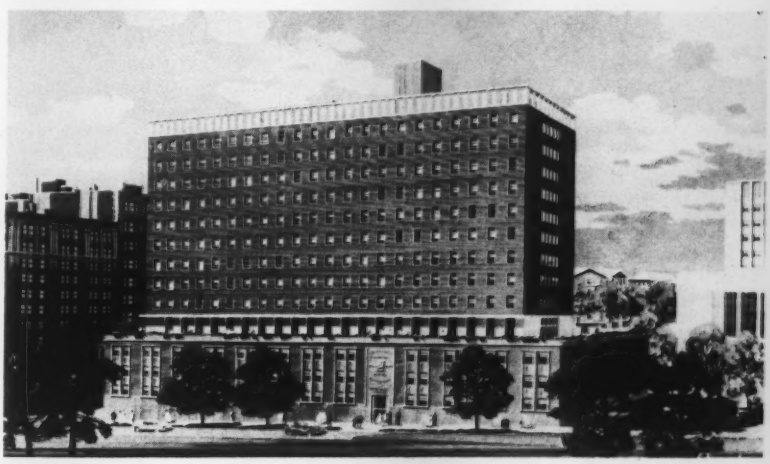
[*Cal. Klaters were S. K. Rueball (Keith Jones), Thatchrite (Guy C. Thatcher), Ed C. Holt Jr., James R. Bole, E. Nigma (Mrs. Robert E. Craig II), Emerson Boyd Jr., and John A. Tweed. Guest Professor Kum Pewter is Walter Steinbruch. Also acknowledged is a solution of the February melon problem from Ming L. Pei.*]

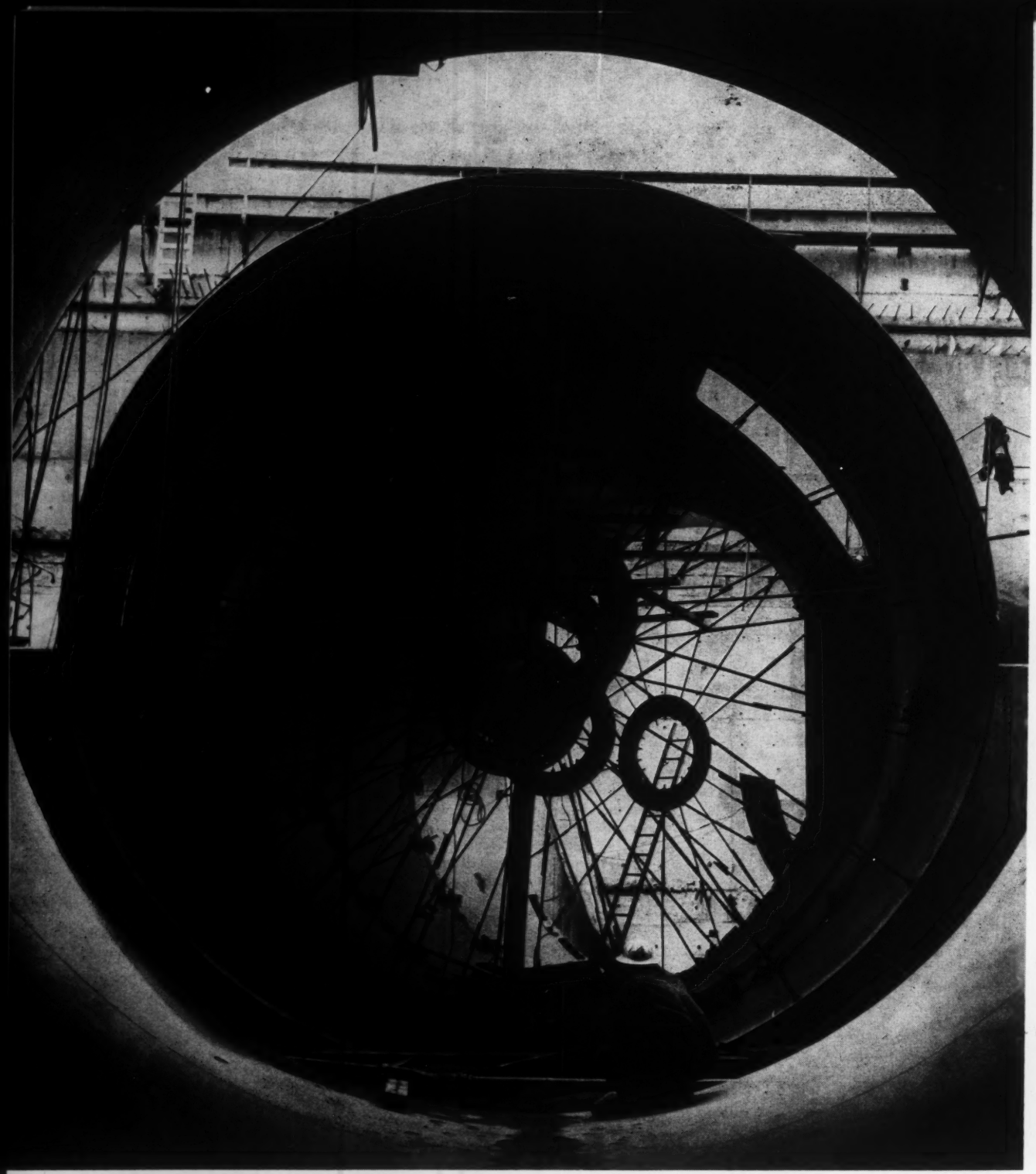
AWWA Award to Civil Engineering Student

John Grimmer, president of the Marquette University Student Chapter and a March 1959 civil engineering graduate, has been awarded the American Water Works Association Scholarship for 1959. The $1,500 AWWA award is made annually on the basis of interest in water works operation or management. Mr. Grimmer will use his scholarship toward a master's degree in water-works administration. The scholarship is called the Harry E. Jordan Award.

Columbia University to Have New Engineering Center

Ground was broken on April 4 for Columbia University's new Engineering Center. First unit to be erected in the Center is the Seeley Wintersmith Mudd Building, depicted here in artist's sketch. The 13-story, air-conditioned building—to be erected on the university campus at 120th Street and Amsterdam Avenue—will cost about $8.3 million. It will contain classrooms, laboratories, and administrative offices for the civil, electrical, industrial, mining, mechanical, and chemical engineering departments. Architects for the building are the New York firm of Voorhees, Walker, Smith, Smith and Haines. Charles Mayer, M. ASCE, is structural engineer, and ASCE Past-President Richard E. Dougherty is chairman of the Planning Committee for the Center. Funds for the new building were provided by the Seeley Wintersmith Mudd Foundation, formed by the late Della M. Mudd in memory of her husband, Seeley Wintersmith Mudd, Hon. M. ASCE, a pioneer in mining enterprises.





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Because of the fierce pressure and erosive action of the water, it was obvious that a very strong, abrasion-resisting steel was required. USS "T-1" Constructional Alloy Steel not only met these requirements, but permitted a reduction of about 50% in plate thickness.

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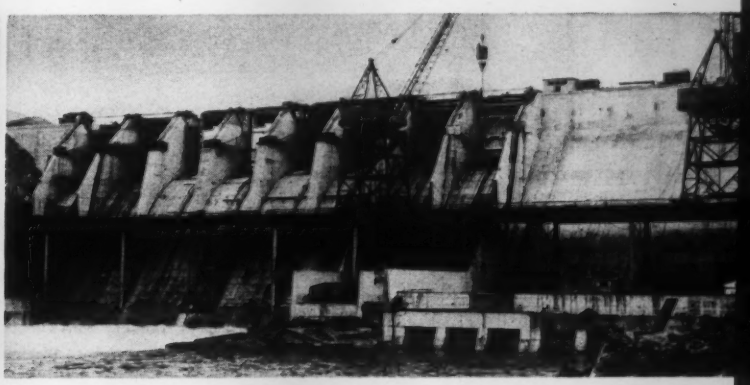
Nation's largest scroll cases. Built with USS "T-1" Steel to obtain maximum strength with the least weight. Largest diameter is 24 feet with a speed ring about 28 feet in diameter.



Noxon Rapids Dam, a new $87,000,000 power project by the Washington Water Power Authority to harness the waters of Clark Fork River in western Montana. General Contractor: Morrison-Knudsen Company.

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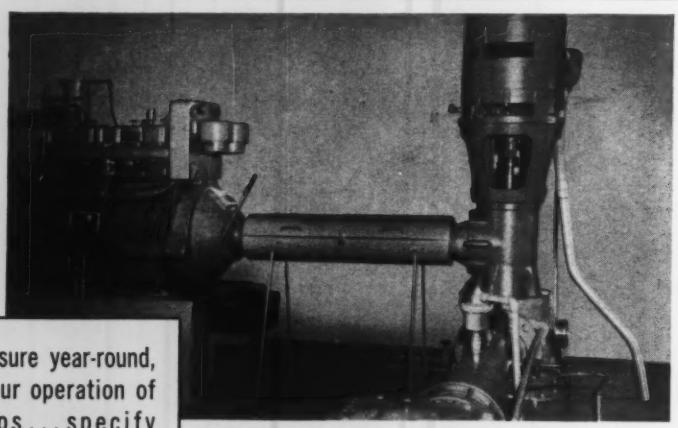

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DECEASED

Wayne A. Clark (M. '13), age 82, a former member of the Duluth City Planning Commission and a retired civil engineer, died in Duluth, Minn., on March 13. In recognition of Mr. Clark's service on the commission from its creation in 1922 to 1947, the City Council appointed him an honorary and advisory member when he resigned. He was chief engineer of the now defunct Iron Range Railroad from 1907 to 1930, and of the Duluth, Missabe and Iron Range Railway from the latter year until his retirement in 1945. Mr. Clark received a B.S. degree in 1900 from the Case School of Technology, and a civil engineering degree six years later.

Harold Hawley Corson (M. '32), age 73, consulting engineer of Birmingham, Mich., died there on March 7. Mr. Corson retired in 1948 after serving as city engineer, treasurer, and acting city manager of Birmingham in a 20-year period. Previously he was employed by the U.S. Bureau of Reclamation and the Michigan State Highway Department engaged in design and construction work, surveying, and standards and accounting. In 1907 he received a B.S. from the University of Michigan.

Robert Joseph DuPlessis (A.M. '53), age 48, office engineer for the Corps of Engineers at the Plattsburg (N. Y.) Air Force Base, died recently. A member of the Corps for nearly twenty years, Mr. DuPlessis served as assistant area engineer for the Boston District; resident engineer for the Providence District, where he had complete charge of construction of ordnance facilities at Worcester, Mass.; and contract administrator for the New York District on a $23,000,000 rehabilitation program at Sampson Air Force Base.

Victor Marcus Ehlers (M. '38), age 75, director of the Texas Bureau of Sanitary Engineering and public health pioneer, died in Austin, Tex., on March 20. A graduate of Texas A. & M. College in 1905 and Cornell University (C.E. degree) in 1910, he launched his career in Texas as a consulting engineer, designing a number of municipal sewer systems. The post of sanitary inspector in the Texas State Health Department was created in 1915 as a result of his efforts to clean up stream pollution. Mr. Ehlers filled this post and later was chief sanitary engineer and eventually director of the Bureau of Sanitary Engineering. In the latter capacity he led the fight against the high incidence of typhoid fever and other water-borne diseases by getting cities to treat their drinking water and install sewage treatment plants. He was instrumental in the formation of many state health organizations and had received many honors for his contributions

(Continued on page 104)

Architects of the Smithsonian's new museum building are McKim, Mead & White. *Associate architects:* Mills, Petticord & Mills; *foundation consulting engineer and structural engineer:* Severud, Elstad & Krueger; *general contractor:* Spencer, White and Prentiss.

160,000 linear feet of steel H-piles for new museum in Washington

Foundation work for the Smithsonian Institution's new Museum of History and Technology in Washington, D. C., required over 4,000 tons of steel H-piles—approximately 160,000 linear feet—supplied by Bethlehem. The steel piles are about 53 ft in length.

The new $36 million museum will rise on the famous Mall of the nation's capital, not far from other buildings of the Smithsonian. In order for pile-driving operations at the subgrade level to be carried out, two heavy-duty pumps worked 24 hours a day to keep water from the excavation. It was estimated that if it were not for the pumps, the site would be under 10 ft of water.

Steel H-piles, used more than ever for the foundations of multi-story, monumental type buildings, are economical. They carry high loads per pile with a liberal factor of safety.

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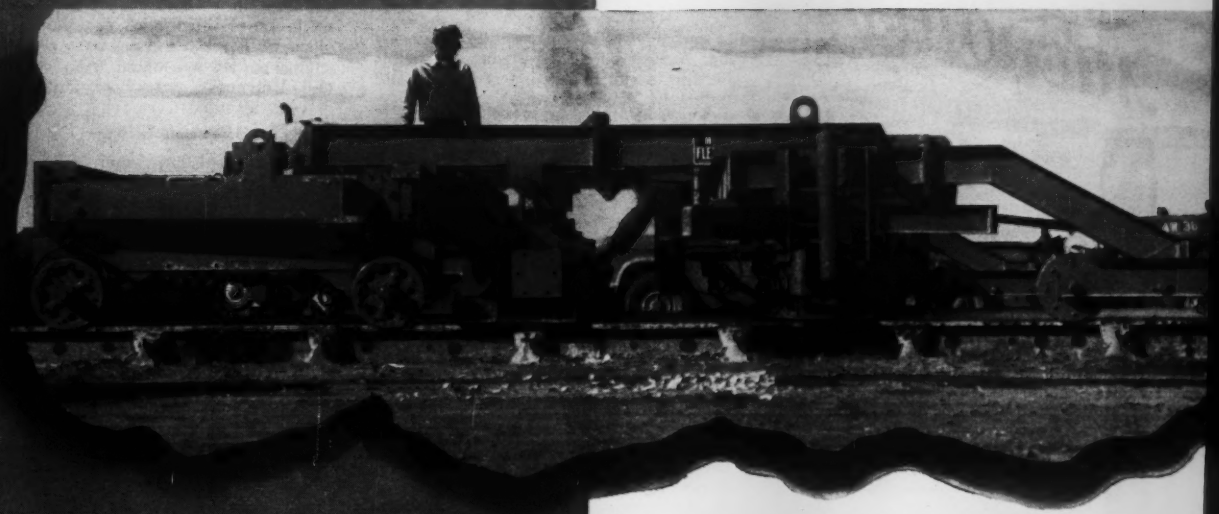

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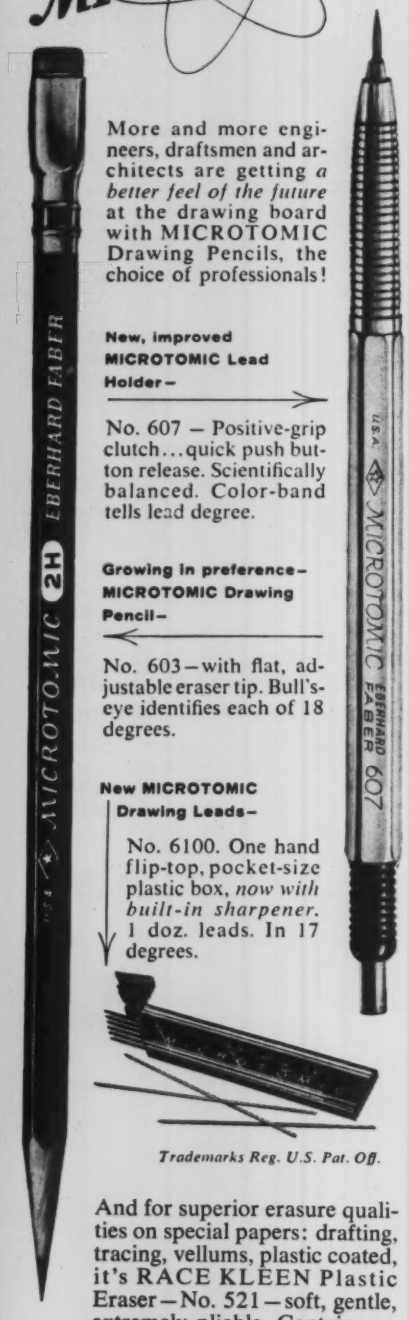

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110th Anniversary, 1849-1959

EBERHARD FABER

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Deceased

(Continued from page 100)

to public health and sanitary engineering. Among these were honorary membership in the Federation of Sewage and Industrial Wastes Associations, which he had served as president.

Viggo Hansen (M. '39), age 69, engineer in charge of the Structural Division of the Philadelphia Electric Company, was killed in a recent airplane crash near Conowingo, Md. Mr. Hansen retired last October after twenty-one years with the company. His home was in Upper Darby, Pa. In 1912 he received his B.S. in civil engineering from the University of Illinois.

Edward Harper Thomas (M. '47), age 52, principal bridge engineer of the Washington Toll Bridge Authority, Olympia, Wash., died there recently. One of the nation's outstanding bridge engineers, Mr. Thomas worked with C. E. Andrew, M. ASCE, on the design of the Lake Washington Floating Bridge and was also on the engineering staff that designed the Aurora Bridge in Seattle. Although most of his career was as an engineer for the State of Washington, he was for a time chief bridge engineer for the Montana State Highway Department. In recent years he was engaged on the design of the second Lake Washington Bridge and the proposed new bridges across Puget Sound and Hood Canal.

Henry Banks Henderson (M. '20), age 87, retired president of Cowin and Company, structural engineers of Winnipeg, Canada, died there on March 3. Mr. Henderson, who had been an active figure in the construction industry in western Canada for over thirty years, retired in 1947. He graduated in engineering from Cornell University in 1894, receiving his M.A. in mechanical engineering at MIT in 1896.

Robert A. Huestis (M. '44), age 67, retired specialist in building design and construction, died recently in Solana Beach, Calif. An employee of the Austin Company for almost thirty-two years, he retired in 1956 as project engineer for the Cleveland Heights, Ohio, area. Mr. Huestis was responsible for the Hooker Electro-Chemical plant in Tacoma, Wash.; plant and pier work in Shanghai, China; and Naval defense work in the Puget Sound area. He received his B.S. in civil engineering from the University of Washington in 1917.

Charles Reid Johnson (M. '51), age 67, retired Captain in the U.S. Navy Civil Engineer Corps at La Jolla, Calif., died there on March 7. Captain Johnson won the Legion of Merit for his success in constructing U.S. Navy facilities at Keflavik, Iceland, at the start of World War II. He played a major role in the Normandy invasion, serving as the U.S. representative on the joint British-American project. He designed the artificial harbors and commanded the Seabees along the south coast of England and Europe. Captain Johnson retired from the Navy in 1951 to become director of the San Diego office of Pereira & Luckman, architect-engineers. He graduated from the Cornell University School of Civil Engineering in 1913.

Robert B. Kleinschmidt (A.M. '46), age 49, professor in the University of Buffalo School of Engineering, died there recently. Professor Kleinschmidt taught at Rutgers and Lehigh Universities prior to joining the engineering faculty of the University of Buffalo as an associate professor in 1953. For a number of years he was a regular consultant for the Stromberg-Carlson Company of Rochester, where work on an electronics carillon required the combination of his musical and engineering talents. He was well known as carillonneur at the Rainbow Bridge Tower, Niagara Falls, Ontario. He had played more than 1,800 hours of concerts from the tower. Professor Kleinschmidt held bachelor and master of science degrees in civil engineering and a master of arts in mathematics from the University of Pennsylvania.

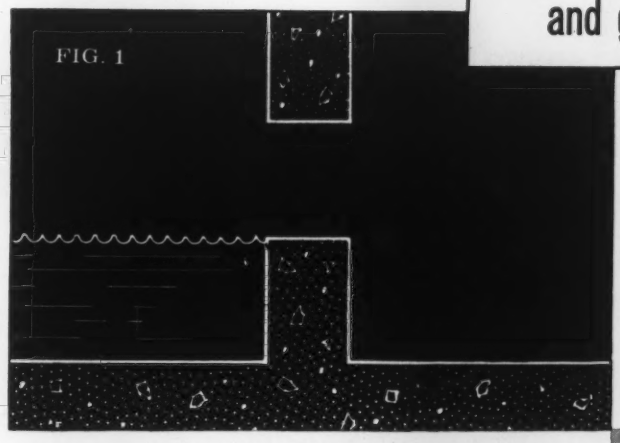
Clarence McKenzie Lewis (A.M. '02), age 83, retired engineer of New York City, died there recently. After graduating from Columbia University with a degree in civil engineering in 1898, Mr. Lewis joined the Baltimore & Ohio Railroad, which he served in various engineering capacities, including bridge engineer. For many years he was with Wm. Salomon & Company, of New York City, leaving in 1929 to go into business for himself as an investment broker and counsel.

Andrew C. Love (M. '12), age 83, retired engineer of Beaumont, Tex., died there recently. A graduate of the Texas A. & M. College, he was a professor of railway engineering at his alma mater for several years. In 1922 he became Jefferson County engineer, in charge of plans and construction of $2,750,000 of highways and bridges. From 1928 until his retirement in 1950 he served the Texas Highway Department as state highway engineer, resident engineer, and senior laboratory and research engineer in Austin.

Robert A. Marr, Jr. (M. '38), age 62, former head of the civil engineering department at Virginia Military Institute and a highway expert, died in Richmond on March 11. A graduate of VMI, Colonel Marr, joined the faculty there in 1919 and became head of the Civil Engineering Department in 1941. He served in this capacity until hospitalized by illness in 1955. Colonel Marr served on a number of Virginia state commissions and study groups, including the Marr Commission which studied highways and traffic. Long active in ASCE, he had been chairman of the Committee

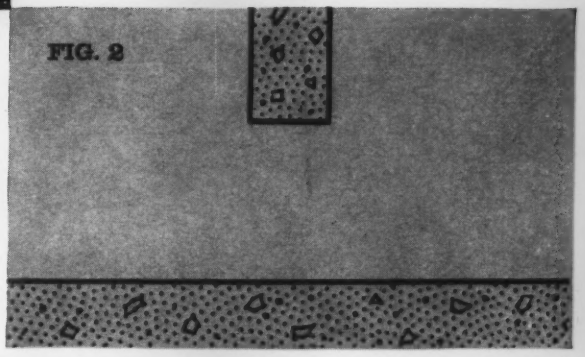
(Continued on page 108)

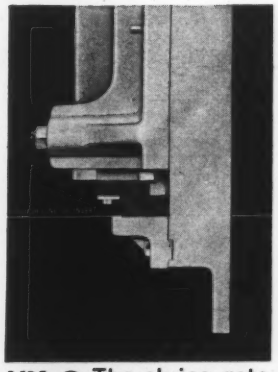
SPECIFY RODNEY HUNT
HY-Q FLUSH BOTTOM SLUICE GATES
and get these **6** design advantages



#2 HY-Q® Sluice Gates Assure Complete Drainage

In many installations it is imperative to effect complete drainage of channel or chamber. With a conventional gate mounted on a vertical sill that may rise as much as 18 inches above the channel floor (Fig. 1), pumping, piping, or other drainage is necessary. The Rodney Hunt HY-Q Sluice Gate (Fig. 2) gives complete drainage because there is no need for the vertical sill. Further, the cost of installing and maintaining auxiliary equipment is eliminated.

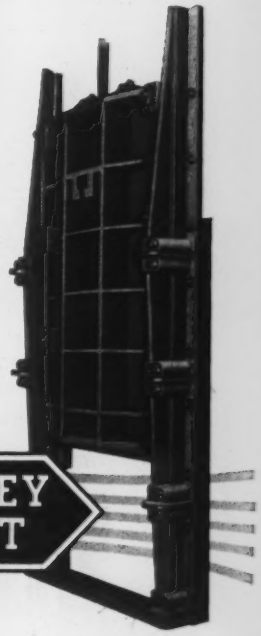




HY-Q The sluice gate with flush-bottom closure

The many advantages of the Rodney Hunt HY-Q Sluice Gate derive from the design of the resilient seal fastened to the bottom of the disc as illustrated at the left. This seal extends the full width of the disc and provides a cushioned closing at the stop bar *flush with the invert.* This flush-bottom closure assures—**1.** maximum flow — **2.** complete drainage without pumps or piping — **3.** elimination of silt and debris problems—**4.** maximum hydraulic gradient—**5.** lowest possible invert—and—**6.** construction economy.

In brief, the HY-Q gate offers unmatched design flexibility and construction economy for water control projects...with hundreds of gate sizes available from 6″ x 6″ to 144″ x 144″ and larger to meet your specific design requirements.



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Water Control Equipment Division
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ENGINEERS SAY:

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"Reduces water costs"

FROM DESIGN THROUGH OPERATION—

Transite Pipe never stops saving you money

Read what leading water system designers, installers and municipal officials say about many economies of Johns-Manville Transite Pipe

MAYOR *Walter Reynolds, Providence, R. I. says—*
"An efficient water system ranks high among the many advantages Providence offers industry. Since 1935, Transite Pipe has ably served in the continuing job of keeping our water system more than capable of meeting future needs. In this way our water system contributes not only to the health and convenience of our citizens, but also to the encouragement of industrial and economic growth in our city."

ENGINEER *Philip J. Holten, Jr., Chief Engineer Water Supply Board, Providence, R. I. says—*
"Transite's installation savings have helped us absorb recent increases in labor and material costs . . . Our records show that labor and material costs have increased 100% since 1946. Yet, in this same period of time, our installation costs have increased only 21%. The ease of handling and speed with which contractors can layTransite Pipe enable us to take full advantage of modern equipment and methods. In this way, Transite has played a prominent part in helping us offset increased costs."

CONTRACTOR *C. J. Fanning, Pres. Fanning & Doorley Construction Co., Providence, R. I. says—*
"You soon see why Transite Pressure Pipe saves time and labor when you're working through old, unmarked utility and service lines. These unforeseen obstacles can cause costly slowdowns, but they present fewer problems with Transite. Its flexibility, easy handling and speed of assembly enable our men to work fast even under the most difficult working conditions. And by the same token—your crews really move along when conditions are favorable."

CONTRACTOR *Frederick J. Gallagher, F. J. Gallagher Trenching Co., Tucson, Arizona says—*
"By using Transite Pressure Pipe, we completed this 70,000-ft. water system contract several weeks faster than we had estimated. Transite's ease of assembly keeps our time and labor costs low. We excavate, install the pipe, and button up the trench fast. This speed is especially advantageous when we encounter cross service lines or are faced with bad weather. And always important, it means less annoyance to our own townspeople and the local merchants."

MAYOR *James L. Gardner, Wichita, Kansas says—*
"Every year—we actively go after new business . . . seek new firms to locate in Wichita to create job and business opportunities for our citizens. These new firms need water—and never fail to ask about our water system . . . which is one of the most efficient systems anywhere in the world. Part of its efficiency is made possible by Johns-Manville Transite Pipe which we have been using for many years."

ENGINEER *Leigh O. Gardner, Yost and Gardner, Engineers, Phoenix, Arizona says—*
"Transite has many advantages contributing to its economy. Its light weight, handleability and easy-to-join Ring-Tite Coupling keep our clients' final costs low. We find a continuing economy of operation throughout its long life. We have excavated lengths of Transite after 20 years of service and have found no sign of tuberculation . . . the smooth inside walls proving it still has low coefficient of friction and therefore highest carrying capacity."

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ZERO-LASTIC® JF

JOINT SEALER for the JET AGE

to Jet Fuels . . . Jet Blasts—

keeps Joints Sealed

UNDER ALL CONDITIONS

Servicised Zero-Lastic JF Sealing Compound is a cold-applied, two component jet fuel resistant, rubberized tar compound specifically designed for sealing expansion, contraction, or dummy joints in concrete paving of airfields. Zero-Lastic JF is easily applied to joints from ¼ " up to 1" or more in width using a pug mill applicator. Once installed, it cures internally into a resilient, rubber-like seal which has excellent bond to both sides of the concrete joint. Since Zero-Lastic JF contains no thinner, there is no shrinkage after placing in the joint.

Because Zero-Lastic JF is unaffected by jet blast, jet fuel or other petroleum solvents used by aircraft, joints sealed with the material stay sealed under the most adverse aircraft re-fueling and maintenance conditions. Zero-Lastic JF can be used with equal efficiency to seal joints in new or old concrete pavement joints.

Write for complete details on Zero-Lastic JF and other Servicised Joint Sealing Compounds.

SERVICISED PRODUCTS
CORPORATION
6051 WEST 65th STREET • CHICAGO 38, ILLINOIS

Deceased

(Continued from page 104)

on Junior Members and vice-chairman of the Committee on Student Chapters.

Thomas J. Mitchell (M. '36), age 70, retired works manager of the Poinsett Lumber Company at Pickens, S. C., died there recently. After graduating with honors in civil engineering from the University of Michigan, Mr. Mitchell returned to his alma mater where he taught for thirteen years. In 1939 he joined the Poinsett Lumber Company as works manager of the Pickens plant. Mr. Mitchell retired in 1956.

Garfield Hugh Russell (M. '35), age 78, retired engineer of Oakland, Calif., died there recently. A civil engineering graduate of the University of Michigan in 1908, Mr. Russell specialized in the appraisal and supervision of irrigation and water supply systems. At the time of his retirement in 1950 he had been with the Farm Credit Administration for eight years. From 1935 to 1942 he was senior engineer-appraiser with the Federal Land Bank of Berkeley (Calif.), a farm loan agency.

John B. Saxe (M. '54), age 56, since 1957 vice president and chief consulting engineer of Gibbs & Hill, Inc., of New York City, died recently in Westfield, N. J., where he lived. A 1923 civil engineering graduate of Harvard Engineering School, Mr. Saxe had been with Gibbs & Hill since 1924. He became chief mechanical engineer in 1945, chief engineer in 1953, and a vice president in 1954.

James P. Slater (A.M. '41), age 53, director of the Division of Sanitation of the San Diego County Surveyors Office, San Diego, Calif., died there recently. Prior to becoming director in 1956 he was chief public health engineer of the City-County Health Department in San Diego; chief sanitary engineer of the Tulsa City-County Health Department in Oklahoma; and chief sanitary engineer of the Little Rock City Health Department in Arkansas. Mr. Slater attended the University of Arkansas, Arkansas State, and the University of Michigan.

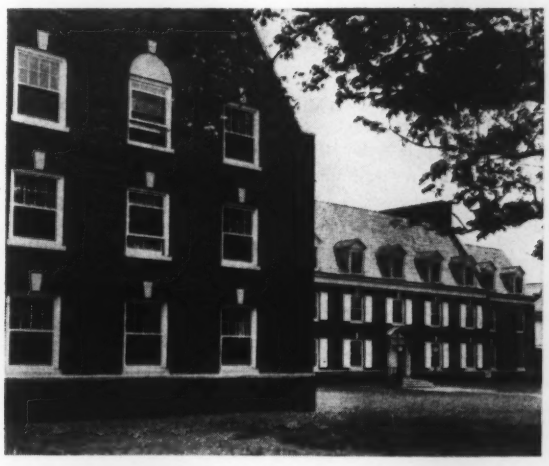
Frederick Burr Spencer (M. '29), age 68, retired vice president of Spencer, White & Prentis, Inc., construction engineering firm of New York City, died there recently. From 1950 until his retirement last fall Mr. Spencer was vice-president of Spencer, White & Prentis. From 1923 to 1933, while president of

(Continued on page 110)

Women's Dormitory "A", State University College For Teachers at Albany. Accommodates 200 students.

Owner: Dormitory Authority of the State of New York
Architect: H. O. Fullerton, Albany, N.Y.
Contractor: Sano-Rubin Construction Co., Inc., Albany, N.Y.
Dealer: Builders Material & Supply of Albany, Inc., Albany, N.Y.

Closeup shows results of good design, good workmanship and quality materials. Lehigh Mortar Cement was used with brick, block and structural tile.



• This new dormitory is an excellent example of warm colonial design—its beauty and durability enhanced by good workmanship, and quality materials.

The contractor, Sano-Rubin Construction Company, chose Lehigh Mortar Cement for all masonry. They report "We had used Lehigh Mortar Cement on many previous jobs and have always been more than satisfied with this mortar, and the results produced."

The workability and plasticity of Lehigh Mortar Cement help masons do a good job. Its uniformity and durability contribute to clean, strong, weathertight walls.

Try Lehigh Mortar Cement on your next job. See for yourself how it can help you produce top quality masonry construction.

• LEHIGH MORTAR CEMENT • LEHIGH EARLY STRENGTH CEMENT
• LEHIGH AIR-ENTRAINING CEMENT • LEHIGH PORTLAND CEMENT

Lehigh Portland Cement Co.
ALLENTOWN, PA.

PROVIDE WATERTIGHT JOINTS IN CONCRETE CONSTRUCTION WITH...

Note Exclusive Rib Design

SEALTIGHT®

POLYVINYLCHLORIDE PVC WATERSTOPS

SPECIFICATIONS

Specific Gravity ..... 1.28 Max.
Durometer Hardness ..... 80 ± 3
Tensile Strength....2600 PSI Min.
Elongation ..... 350% Min.
Temperature Range .... from +176°F - —50°F
Cold Brittleness Test .... —50°F ASTM D746 —55T
Chemically resistant to chlorinated water, salt water, acids, alkalis, sewage wastes, oil, etc.

SEALTIGHT PVC Waterstops are extruded from a special PVC compound with added plasticizer and stabilizer to provide all of the necessary qualifications of a true waterstop. The exclusive cross-section design features a unique rib that has a vertical surface on the leading edge and a diagonal surface on the trailing edge to provide a tenacious grip to the concrete in which the waterstop is embedded . . . the special center bulb provides the ability for the waterstop to successfully handle tremendous pressures caused by concrete movements. SEALTIGHT PVC Waterstops are strong and flexible . . . on-the-job splicing may be accomplished quick and easy without special equipment. Ideal for installation in concrete structures of all types. SEALTIGHT PVC Waterstops offer the construction industry the top-quality product in its field at a competitive price . . . specify SEALTIGHT PVC Waterstops when you want a 100% watertight joint.

OTHER SEALTIGHT PRODUCTS

- "PREMOULDED MEMBRANE" . . . the industry's only TRUE VAPOR SEAL.
- "CORKTITE" impermeable Perimeter Insulation.
- "HYDROMAT" Asphalt Liners.
- Expansion Joints of all types.
- Joint Sealing Compounds.
- Tongue and Groove Centerstrip.
- Air Entraining Agents.
- Concrete Curing Compounds.

W. R. MEADOWS, INC.
20 KIMBALL ST. • ELGIN, ILLINOIS

Deceased

(Continued from page 108)

Spencer & Ross, Inc., foundation builders in Detroit, Mich., he worked on the Cleveland Union Terminal. He also worked on the Book-Cadillac Hotel and the J. L. Hudson department store, both in Detroit. Mr. Spencer received an A.B. degree in 1911 and a Civil Engineering degree in 1913 from Columbia University.

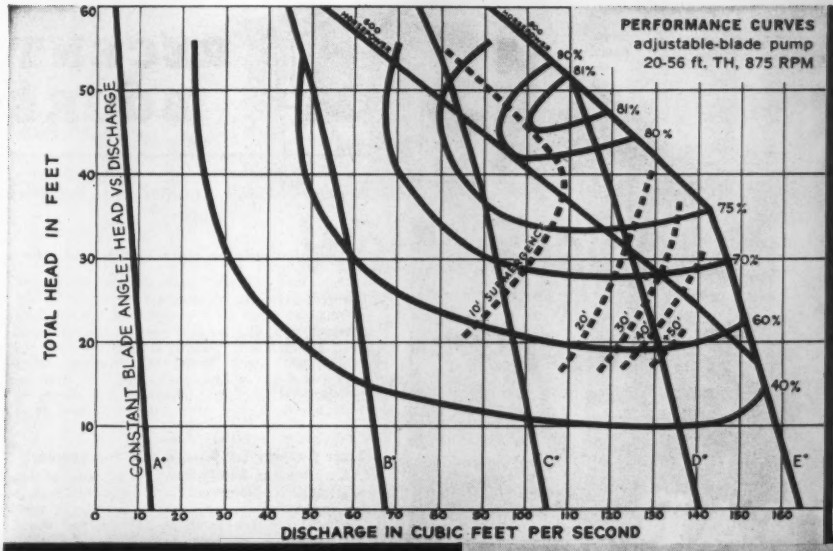
Thomas J. Strickler (M. '16), age 75, retired executive of the Missouri Gas Service Company, Kansas City, Mo., died there recently. From 1927 until 1947, Mr. Strickler served as vice president and manager of the Kansas City office of the Missouri Gas Company, and in 1947 when that firm merged with Gas Service, he became vice president of the Kansas City Division. A 1906 graduate of the University of Kansas with a B.S. in civil engineering he passed the Kansas state bar examination in 1917 after night classes at Washburn University. He had been with the U. S. Bureau of Reclamation as an engineer on dam construction in Wyoming and Montana. He was chief engineer of the Kansas Public Service Commission from 1913 to 1920.

Robert E. Turner (M. '41), age 57, a plant engineer of the Susquehanna Power and Light Company, an affiliate of Philadelphia Electric, died in Conowingo, Md., recently, the result of a plane crash. A graduate of Iowa State College, Mr. Turner did graduate work at the University of Pennsylvania, Johns Hopkins University and Alden Hydraulic Laboratory of Worcester Polytechnic Institute. Since joining the Susquehanna Power and Light Company in 1927, he had served as a hydrographer and for the past year as plant engineer.

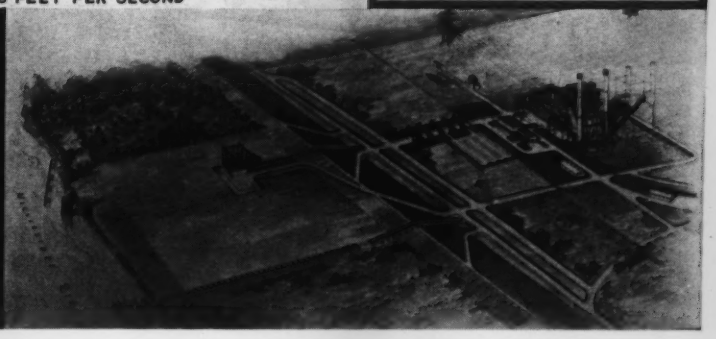
Harold C. Whittlesey (M. '42), age 62, consulting engineer of Los Angeles, Calif., died there recently. Mr. Whittlesey entered private practice in 1936 in Los Angeles, after several years as structural engineer with the California Division of Architecture. He graduated from the University of California in 1919.

Whitby F. Wise, Jr. (A.M. '28), age 69, president of the Southwest Stone Company, of Dallas, Tex., died there recently. A graduate of Texas A. & M. College in 1909, Mr. Wise had been president of the company since 1919.

Stanley H. Wright (M. '24), age 72, Eastern branch manager of Holmes & Narver, Inc., a Los Angeles engineering firm with offices in Washington, D. C., died there recently. He had been a member of the firm for the past four years. Mr. Wright went to Washington in 1939 to work for the Bureau of the Budget. He also worked for the Atomic Energy Commission for ten years prior to joining Holmes & Narver.



Performance curves of the A-C adjustable-blade axial flow pumps for Willow Glen illustrate their extreme flexibility. Pump operation is not restricted to a single head-discharge curve as is the case with fixed-blade pumps, but provides any discharge and head combination within the limits of motor horsepower and proper submergence.

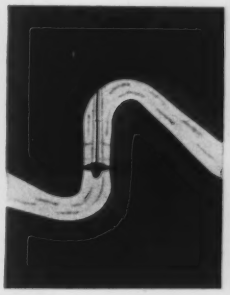


Stone & Webster Engineering Corp. is designing and constructing the Willow Glen Plant at St. Gabriel, La. on the Mississippi River for Gulf States Utilities Co.

Flexibility and efficiency make Allis-Chalmers adjustable-blade pumps choice for Willow Glen

Two 30-inch Allis-Chalmers adjustable-blade axial flow pumps will be installed to provide condenser water for Unit #1 at the new Willow Glen Power Station. To meet requirements at minimum river level, with water temperatures that vary between 39°F and 90°F, the pumps are designed to deliver a total of 76,000 gpm against a 54-foot total head.

Extreme variation of suction pool elevation and the flexible condenser operation required for this station made adjustable-blade pumps the logical and economical choice. A-C adjustable-blade pumps attain relatively high efficiencies over a wide discharge and head range. This is accomplished by varying the pitch of the impeller blades while the pump is operating at constant speed. This adjustability keeps pumping costs at a minimum by combining low starting torque with high average efficiency.



Pump Bulletin 165 will give you complete information on high capacity axial flow pumps. To get your copy, write to Allis-Chalmers Manufacturing Co., Hydraulic Division, York, Penna.

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Basic Geology for Science and Engineering

A systematic development of physical geology with particular emphasis on those principles suitable for engineering application. Among the topics discussed are soil materials, physical and chemical properties of rock materials, soil forming processes, streams, shoreline processes, ground water, wind deposits, and crustal deformation. A considerable number of tables and graphs have been included. (By E. C. Dapples. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1959. 609 pp., bound. $9.50.)

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A handbook, written by various authorities, which covers mechanics of materials, stresses in framed structures, steel design, highway and airport engineering, water supply, sewage disposal, and other aspects of civil engineering. In this present edition new and expanded material appears on photogrammetric surveying, interstate highway system requirements, soil classification, flow in pipes and channels, stresses in continuous beams and frames, welded steel construction, and reproportioning concrete mixtures for air entrainment. (Edited by Leonard Church Urquhart. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1959. 1184 pp., paper. $17.50.)

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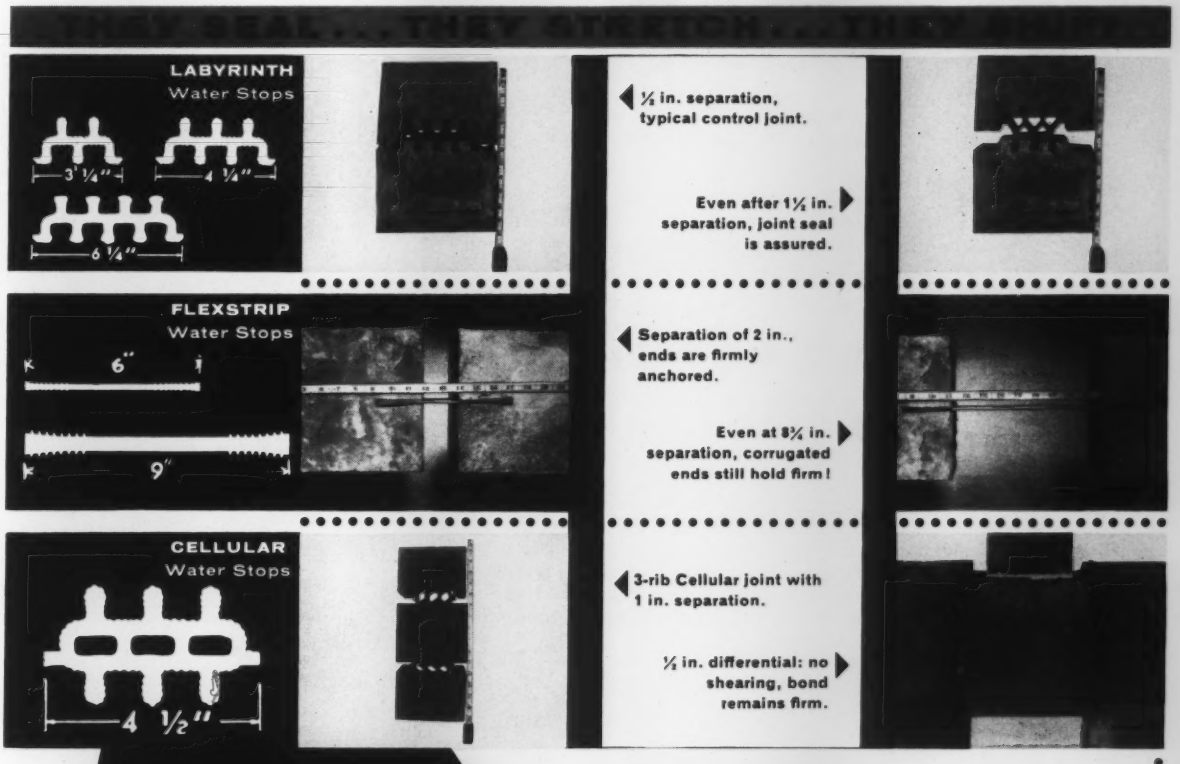
The sewage project is covered from its inception to design, construction, operation, and maintenance. In this revised edition, new material on oxidation ponds has been included, and the attention to practice in sludge treatment and disposal has been increased. Additional information is also given on the subject of stream-pollution prevention and the oxygen-sag curve. A review of the literature since the last edition in 1952 is presented and approximately half the illustrations are new or revised. (By Harold E. Babbitt and E. Robert Baumann. John Wiley and

(Continued on page 121)

Look at PROOF of Water Seals' performance!

Here's why they are the Waterstop your jobs deserve

Grueling laboratory tests merely bear out what years of experience on countless jobs have proved: to *stop water* seepage between successive concrete pours, there's no water stop to match Water Seals. Made of the finest polyvinyl chloride resin, Water Seals are unaffected by acids, alkalies, organic chemicals: their bond is sure and water tight even at 150°F and against heads of 200 feet. And they're installed at a fraction of the cost of other types—and much faster. Cut and spliced in the field with a hot knife. Every good water-proof concrete job design should include Water Seals water stops. These pictures show why . . .



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JOHN ROLLER BOOTON, Richmond, Va.
LEO MATHIAS BUHR, Portland, Ore.
FLOYD EDWARD BURROUGHS, Indianapolis, Ind.
LAWRENCE SIMAN CAIN, Miami, Fla.
DEAN FREDERICK COBURN, Boston, Mass.
LUKE ALEXANDER CUNNINGHAM, Chicago, Ill.
FREDERIC ARMSTRONG DAVIDSON, JR., Long Island City, N. Y.
ELDON DAVIS, Honolulu, Hawaii
RICHARD EUGENE DEFFEBACH, Arcadia, Calif.
LESTER EDGAR DEHART, Youngstown, Ohio
MORRIS DROSKIN, McCook, Nebr.
CHARLES MARSDEN DUKE, Arlington, Va.
JAMES GUS FOYLE, Orange, Tex.
GALE ARTHUR FROEMMING, Milwaukee, Wis.
CARLETON THERON GARRETT, Harrisburg, Pa.
JAMES FLETCHER GORE, West Memphis, Ark.
PERCY PORCHER GREGG, Norfolk, Va.
JAMES FRANCIS HALEY, Cambridge, Mass.
WILLIAM JOHN HALLAHAN, Boston, Mass.
ARTHUR LEONARD HELD, JR., Detroit, Mich.
ANDRES Y OCHOA HIZON, Quezon, Philippines
HAROLD BENJAMIN HUSTED, Youngstown, Ohio
HALLARD BANKS KINNISON, Washington, D. C.
CHARLES JAMES LAWRENCE, JR., Wilmington, Del.
SIDNEY CLEMENT LEVEROCK, New York, N. Y.
RANDOLPH MCLAUGHLIN MARTIN, Vancouver, B. C.
JOSEPH ROGER MCCAMMON, New York, N. Y.
NEAL BURGESS MITCHELL, Salem, Mass.
VERGIL STEPHENS MURPHY, New York, N. Y.
JACK NASSER, Beirut, Lebanon
ALPHA AMEGA NEWBERRY, Aiken, S. C.
ROBERT NINESTEEL, New York, N. Y.
VLADIMIR FEDOR OBRCIAN, New York, N. Y.
SILAS RAYMOND OVERHOLSER, Sacramento, Calif.
THEODORE THOMAS PANTALEO, Annapolis, Md.
ERNEST LUTHER PEMBERTON, Amarillo, Tex.
ABBOTT LAWRENCE PENNIMAN, JR., Baltimore, Md.
HERBERT GEORGE POERTNER, St. Louis, Mo.
GEORGE BYRON RAAB, Stockton, Calif.
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WILLIAM HOSEA ROBERTSON, Falls Church, Va.
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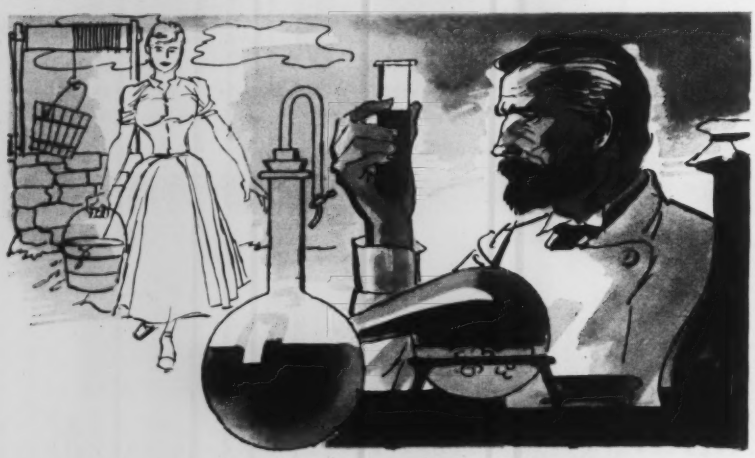
CARL EMIL ROHDE, Portland, Ore.
GILBERT EVERT ROPES, Detroit, Mich.
ENRIQUE CARLOS ROWE MARTINEZ, Santiago, Chile
MAXMILLIAN MIKSA SCHIFFER, Niagara Falls, N. Y.
CLAYTON GROVE SEITZ, San Mateo, Calif.
WILLIAM HENRY SHERMAN, New York, N. Y.
PHILIP CRANE SMITH, Hartford, Conn.
WILLIAM RUTHVEN SMITH, JR., Breaux Bridge, La.
CLEMENS EUGENE SPELLMAN, Port Hueneme, Calif.
JAMES RICH STEERS, New York, N. Y.
ALBERT FRANKLIN STEM, New York, N. Y.
MAX WILLIAM STRAUSS, Los Angeles, Calif.
ADAM THEODORE SYROP, New York, N. Y.
JOHN ARTHUR THOMAS, Montreal, Que., Canada
MARION WELLFORD, Sarasota, Fla.
LANGFITT BOWDITCH WILBY, Vicksburg, Miss.
CONSTANTINO WLADISLAWO KOVACEVICH, Asuncion, Paraguay
HENRY ROBERT WOODSTONE, New York, N. Y.
LAWRENCE SHORES WOOLSEY, Little Rock, Ark.
HAROLD ZWEIG, Gary, Ind.

Applying for Associate Member

LOUIS ALLEVATO, San Mateo, Calif.
JORGE ENRIQUE ALVARDO CANON, Bogota, Colombia
MUNIRATHNA ANANDAKRISHNAN, Minneapolis, Minn.
JESSE RALPH ANDERSON, JR., Chicago, Ill.
ROBERT WILLIAM ANDRES, Walla Walla, Wash.
SOLOMON BANKOLE AUDIFFEREN, Lafayette, Ind.
ROBERT WILLIAM AUSTIN, Sacramento, Calif.
HANS WALTER BERGHOLZ WISSING, Urbana, Ill.
LEO VICTOR BOGGIS, Chicago, Ill.
ROBERT NAILL BOND, Baltimore, Md.
MICHAEL DERMOT CANAVAN, Kuala Lumpur, Malaya
FRANCISCO JULIAN CARVAJAL, New York, N. Y.
MERLE BURDETTE CLAYTON, Baltimore, Md.
ALLAN CONRAD, San Francisco, Calif.
RAYMOND COOK, Kuala Lumpur, Malaya
ROBERT LAWRENCE COOK, Millbrae, Calif.
DAVID JAMES COUGHLIN, Milwaukee, Wis.
DENNIS EDWARD COX, Baghdad, Iraq
ANTHONY D'ALESSANDRO, Buffalo, N. Y.
CLIFFORD JOHN DARKE, Harrisburg, Pa.
HILTON AHIRAM DASILVEIRA, Denver, Colo.
RUDOLPH DE QUATTRO, Providence, R. I.
MATTHEW MCCARTNEY DOUGLASS, Washington, D. C.
WALTER LEE DUNN, Seattle, Wash.
PAUL WILBERFORCE EASTMAN, JR., Washington, D. C.
CLIFFORD JOHN EVANS, Kingston, Jamaica
ROBERT LESLIE FEATHER, Albuquerque, N. Mex.
JOHN E. FEYEREISEN, Zurich, Switzerland
MILTON ALFRED FISCHER, Arlington, Va.
NORBERT BENNETT FRITZ, Green Bay, Wis.
IVAN TAKESHI FUJINAKA, Pearl City, Hawaii
NORRIS RAY GABRIEL, Memphis, Tenn.
DONALD GAMMIE, Cape Town, South Africa
EDWARD THOMAS GATES, Kent, Wash.
GUERRINO RATKO CARLO GERMANIS, Wellington, New Zealand
LEON ASLAN GRILLI, New York, N. Y.
STEPHEN GYIMESI, Long Island City, N. Y.
LYNN ROHLING HAGEMEISTER, Middletown, Ohio
PHILIP ANTHONY COLLINGS HALLIER, Rhodesia, South Africa
DALE JOSEPH HENRY, Memphis, Tenn.
LOUIS ALLEN HILL, JR., Tempe, Ariz.
JAMES GORDON STUART HIRTLE, Montreal, Canada
CHESTER ALBERT HOGENTOGLER, Washington, D. C.
WALTER SEARLE HULSE, JR., Trenton, Mich.
JAMES WELCOME HUNT, Topeka, Kans.
RICHARD JEFFERDS HUYCK, San Francisco, Calif.
MARVIN LEROY JACOBS, Camp Smith, Hawaii
PAUL ROBERT JASPER, Brunswick, Ga.
CLINTON GRANT JONES, Juneau, Alaska
ARTHUR JOSEPH KENLAN, Elizabeth, N. J.
KARL HERBERT KINDER, Boston, Mass.
SIMON LAMAR, Caracas, Venezuela
WILLIAM ARTHUR LAMB, Philadelphia, Pa.
HENDRIK LAUGA, Victoria, B. C., Canada
FUN-CHONG WONG LEE, Mobile, Ala.
ALEJANDRO LEON DE LA BARRA DEL RIO, Mexico, D. F. Mexico
ANTONIO MONTELIBANO LOCSIN, Manila, Philippines
KHALIL MICHAEL MALOUF, Beirut, Lebanon
ALVIN FRANCIS MARCHIGIANI, Bethesda, Md.
KENNETH VERNON MARR, Sacramento, Calif.
JOHN CLAPPER MARTIN, Denver, Colo.
JOHN HENRY MARTINDALE, JR., Bloomington, Ind.
DOMENIC JOHN MASSIMILIAN, Albany, N. Y.
WARREN WILLIAM MATTHESEN, New York, N. Y.
LINNS JOHN MEISCH, St. Paul, Minn.
CHARLES CALLOWAY MIDDLETON, JR., Aiken, S. C.
ABDUL HAKIM MINHAS, Denver, Colo.
JOSEPH WILLIAM MIORELLI, Pittsburgh, Pa.
MORRIS MITCHELL, Chattanooga, Tenn.
NANDIVADA MOHAN RAO, Washington, D. C.
JOSEPH WALTER MONROE, San Carlos, Calif.
SAMUEL CARL MOORE, Montgomery, Ala.
PETER JOSEPH MOTISI, Montgomery, Ala.
MARVIN GEORGE NACHTSHEIM, Millbrae, Calif.
RUSSELL BIEBER NEAL, Chicago, Ill.
MCLEOD CREIGHTON NIGELS, Leesburg, Fla.
NANDA NIMALASURIYA, Colombo, Ceylon
GRANT OWEN OTIS, Tacoma, Wash.
RICHARD RAINE PETTIGREW, Bishop, Calif.
WILLIAM AUGUSTUS PHANG, Lafayette, Ind.
MARVIN MILLARD POSS, Juneau, Alaska

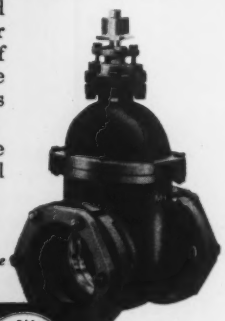
(Continued on page 116)



WHAT BECAME OF TYPHOID?

Not until after 1900 (about 55 years ago) did U. S. citizens really accept public water supply systems as sources of potable water. Scientists discovered water borne disease germs in 1875. It then required about 30 years for the people to believe that such serious diseases as dysentery, cholera and typhoid fever epidemics were due to germs in their drinking water. Finally they realized that water could be clear, cold and fresh tasting, yet dangerous to drink. The water works industry therefore built treatment plants . . . sand filters and chemical feeders. The public abandoned private wells. Today, water-borne disease in America has virtually disappeared. In some 50 years, the U. S. typhoid death rate has dropped from 200 to less than 1 per 100,000 persons. Hippocrates, the "Father of Medicine", in 400 B. C., told the Greek people to boil water before drinking it, but today America's public water supplies are safe.

The water works superintendent in a real sense today is a custodian of public health and a vital force in the Nation's economy.



This Series is an attempt to put into words some appreciation of the water works men of the United States.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF W WALWORTH

47 Tons of Roebling Guys Keep TV Tower in Clear View of 2,464,500 People

The grand, new (1526 ft) WIS-TV transmitting tower in Columbia, South Carolina is, among other things, the fourth tallest man-made structure in the world, with a built-in wind resistance up to 145 miles per hour. This ethereal eminence means an increase of almost 100% in the number of WIS-TV's potential viewers.

Maintaining the tower's sway (both literally and figuratively) over the South Carolina market are six sets of Roebling prestretched galvanized bridge strand. Each set consists of varying lengths of prestretched strand: six pieces of 1-5/16" strand at lengths ranging from 705 to 1022 ft, three pieces of 1-3/16" strand of 826, 837 and 858 ft, respectively, three pieces of 1¼" strand in lengths of 1489, 1492 and 1473 ft and six pieces of 1½" diameter from 1662 ft to 1835 ft.

The sky-high demands, these days, made by TV stations require the facilities and experience of a "feet on the ground" organization like John A. Roebling's Sons Corporation. When you are contemplating a third (or even first) highest man-made structure in the world, you will need guys to keep it eminently erect. That is the time to call on Roebling and enlist the aid and facilities of the authority on suspension systems in this, or any other country. This includes bridges, tramways, ski lifts, materials handling, suspended roofs and, as you already know, new heights in market power.

We certainly will be glad to put our "towering experience" at your immediate disposal. Send for our Bridge Division Booklet, address Bridge Division, John A. Roebling's Sons Corporation, Trenton 2, N. J.

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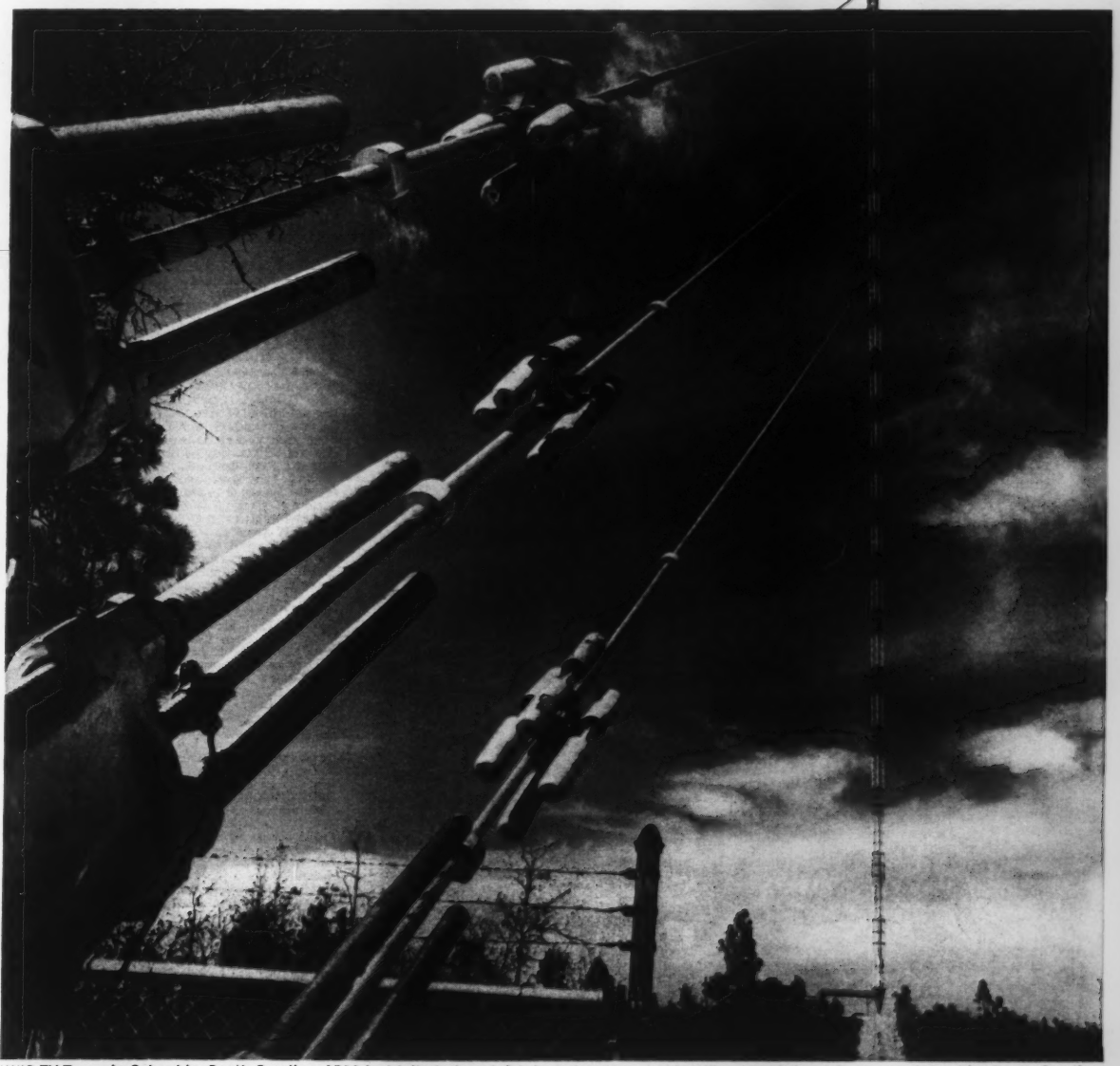
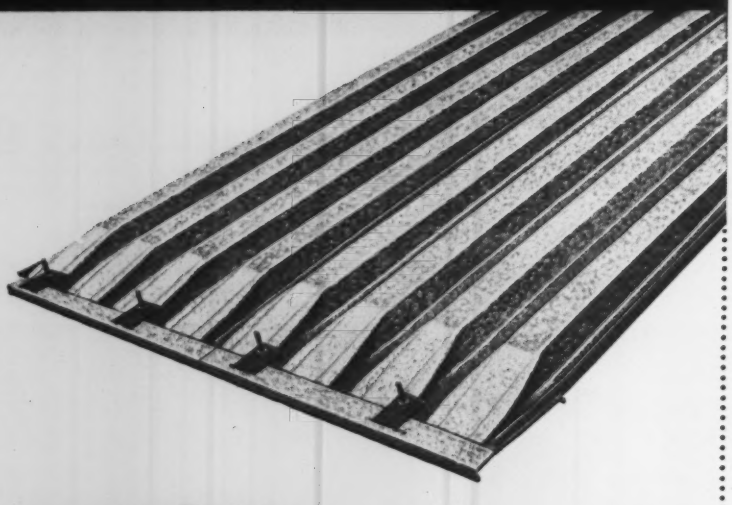


WIS-TV Tower in Columbia, South Carolina, 1526 feet tall, designed, fabricated and erected by Kline Iron & Steel Company, Columbia, South Carolina.

U.S.F.



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schedules (t) removal expense (r) plus
hazardous operations (h) suggest the modern,
time-saving, labor-saving methods
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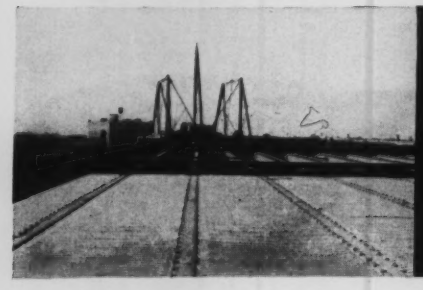
"leave-in-place" **STEEL FORMS**
FOR CONCRETE BRIDGE DECKS

Facts, details and complete data
sent on request by writing...



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Steel Forms for Concrete Bridge Decks
Corrugated Metal Pipe • Window Wells
Metal Doors & Frames • Metal Buildings

Applications

(Continued from page 114)

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RICHARD ATHERLY RAMSEY, Kansas City, Mo.
ALAN EDGAR RANSOM, New York, N. Y.
PAUL GORDON RAPP, Toledo, Ohio
DAVID WARD REEVES, Seattle, Wash.
ROBERT ANDREW RIVERS, Massena, N. Y.
WILLIAM MERRITT ROBBINS, Baltimore, Md.
THOMAS MOORE RUSSELL, Silver Spring, Md.
JAMES ROBERT SANDERS, JR., Jackson, Miss.
HENRY JOSEPH SCHWAB, Philadelphia, Pa.
THOMAS SCRIMSHER, West Sacramento, Calif.
EMANUEL SEIF, New Rochelle, N. Y,
SARTAJ HUSAIN SIDDIQUI, Seattle, Wash.
DANIEL JAMES SMITH, JR., Los Angeles, Calif.
GLEN WINTER SMITH, Los Angeles, Calif.
VICTOR FOUTE SPRUILL, Rolla, Mo.
JOHN SAMUEL STALLINGS, Cullman, Ala.
SHIRLEY ADAM STUTES, Houston, Tex.
HARRY DONALD SUTHERLAND, New York, N. Y.
JACK MURRY SWEETMAN, Pasadena, Calif.
FREDERICK ANTHONY SYNK, Birmingham, Mich.
THEODORE KENNETH TANG, Seattle, Wash.
TSUNEMASA DAVID TERAZAKI, Tokyo, Japan
EDMUND ARWIN THORNTON, Miami Beach, Fla.
WILLIAM RICHARD TRAUTMAN, Oklahoma City, Okla.
LEO JOHN TROMBATORE, Inglewood, Calif.
ALVIN RAYMOND TURSKI, Oakland, Calif.
CHARLES THOMAS WAGNER, Fresno, Calif.
CHOWDHRY ABDUL WAHID, Karachi, Pakistan
MARVIN WEISS, New York, N. Y.
WALTER EDWARD WILLIAMS, Turner, Kans.
FREDERICK VINCENT WITASCHEK, Denver, Colo.
ALBERT SNOWDEN WOODFORD, Pittsburgh, Pa.
EDWARD EMIL WUTHRICH, New York, N. Y.

Applying for Affiliate

JOSEPH REAMY TROY, Richmond, Va.

Applying for Junior Member

WILLIAM RAY ADAMS, JR., Lewiston, Me.
FRANCISCO AGUERREVERE, Stanford, Calif.
ROBERT PHILIP ANDREW, Vicksburg, Miss.
FREDERICK MARTIN ANKLAM, Urbana, Ill.
JULIUS LEMAY BLACKMON, Raleigh, N. C.
VICTOR ARNO BRINGLE, Portland, Ore.
ELMER WHITMORE BROOKER, Alberta, Canada
ROBERT DANIEL BROWN, JR., St. Paul, Minn.
ATTILIO CASTANO, JR., Harrisburg, Pa.
JOHN TIMOTHY CHESSER, JR., Augusta, Ga.
BHISHAM MULCHAND CHOTRANI, Singapore, Malaya
DONALD FORREST COLSON, San Francisco, Calif.
GILBERTO ISAIAS CUADRA, Lexington, Ky.
JOHN HARTLEY DANIELS, Urbana, Ill.
DONALD MORSE DAVISON, Cambridge, Mass.
DONALD HAZEN DAY, San Diego, Calif.
MANUEL ALVIAR DIAZ, Boston, Mass.
PANAYOTIS CHRISTO DIMITRIOU, Evanston, Ill.
MAURICE FARR, Quinault, Wash.
RICHARD MITCHELL GIRLING, Alberta, Canada
JACQUES PIERRE GUILLERY, San Francisco, Calif.
ARNOLD HASSOLDT, Los Angeles, Calif.
ROBERT LEE HINKLE, Chicago, Ill.
ALFRED WARNER HOADLY, New York, N. Y.
JAMES THOMAS HUFFAKER, Baytown, Tex.
THOMAS ANTHONY IERVOLINO, Brooklyn, N. Y.
AHMAD IRSHAD, Manchester, England
STEPHEN LIONEL JENNINGS, Salina, Kans.
CARLOS MA JIMINEZ SOLERA, San Jose, Costa Rica
GERALD LEONARD KAPLAN, Lakewood, Calif.
RICHARD HUGH KEESLING, Mobile, Ala.
RAYMOND EUGENE LASELL, Muscatine, Iowa
CORNELIUS FRANCIS LEMON, Baltimore, Md.
JOHN WESTON LINDBLAD, Napa, Calif.
LEROY JOHN ALBERT LUNDGREN, Pittsburgh, Pa.
THOMAS ARTHUR MANNING, JR., Baton Rouge, La.
ROBERT BURTON MARQUARDT, Bloomington, Minn.
RICHARD DALE MARSHALL, Boulder, Colo.
JOHN FREDERICK MEHNERT, Kansas City, Kans.
RUSSELL LEE MILLS, Indianapolis, Ind.
RYAN DUNNAHOO MITCHELL, JR., Jacksonville, Fla.
HIROSHI MORI, Tokyo, Japan
JOHN THOMAS MORRISSEY, Cincinnati, Ohio
EMILE CYRIL MORTIER, Seattle, Wash.
ARVIND SHAMRAO NADGUDA, Minneapolis, Minn.
ALVIN VERNON PIKE, Los Angeles, Calif.
FRANK ELMER PITTMAN, Chattanooga, Tenn.
CLYDE ALLEN REDMON, Memphis, Tenn.
DOLPH ROTFEID, White Plains, N. Y.
FREDERICK DANA SEARES, Pasadena, Calif.
NIKITA SHKAPSKY, New South Wales, Australia
VICTOR SINGER, Somerville, Mass.
HENRY EARL THOMPSON, Urbana, Ill.
CECIL DENVER WALLACE, JR., Columbus, Ohio
ROBERT JOSEPH WARNAGIERIS, China Lake, Calif.
JOHN DAVID WAUGH, Columbia, S. C.
HANS J. WUEST, Los Angeles, Calif.
CESAR AUGUSTO ZAMORA CARVALLO, Caracas, Venezuela

[Applications for Junior Membership from ASCE Student Chapters are not listed.]

The Case For 105mm Miniaturization of Engineering Drawings

Micro-Master® 105mm, supplied by K&E, is the only system designed specifically for engineering drawings

Micro-Master 105mm offers the general advantages you expect of any miniaturization system – space savings, protection of costly originals, and ready distribution of duplicates. But Micro-Master provides these advantages *without* over-mechanization. A 105mm negative – measuring a generous 4 by 6 inches – is large enough to be located easily and read quickly without elaborate scanning and sorting devices. In addition, a national network of K&E dealers stands ready to provide the 105mm service you need.

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Micro-Master is a totally integrated system for photographing, film processing and final reproduction or projection printing. Completely precision-engineered – from optics through films, papers and chemicals – the system provides extremely sharp, high-contrast "thin" negatives that furnish high-quality, absolutely uniform prints. Critical alignment of camera and projector, and special vacuum frames which hold materials absolutely flat, are typical of the optical and mechanical features that make the Micro-Master system an engineering aid of highest quality.

No Distortion in Blow-Backs

Maximum reduction or enlargement for Micro-Master 105mm is 10 diameters –not up to 30 diameters as with smaller negatives. Thus, when drawings as large as 40 by 60 inches are reduced or reenlarged, they retain a clear, sharp quality – even in the corners. There is no distortion or loss of detail, for all Micro-Master reproductions are made inside the photographic "quality barrier" of 10 diameters. Projection prints can be made on inexpensive paper as well as on cloth or film.

Like-New Prints from Worn Originals

Old originals can be restored, too – even when badly damaged. The Micro-Master process uses *reflected* rather than transmitted light. Thus, detail which has been lost through light absorption – due to dirt or discoloration – will "snap back" on the film – giving you clean prints with clear backgrounds and sharp black lines equal to ink lines. The large negative size makes it easy to see and eliminate unwanted areas by "opaquing out." Any small paint brush can be used for this purpose.

Easy to Read...Always Accessible

You can read almost every detail on a 105mm negative just by holding it up to a window or other light source. Table viewers are recommended for close study, but are *not necessary* in the "search and selection" phase. In a large plant or office, engineers can find and consult from 105mm negatives without waiting for search and delivery of originals, and without having to blow back tiny reductions to a readable size. Engineers or technicians at branch plants, warehouses or field installations can maintain compact, complete files of project information – accessible at any time without special equipment.

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Micro-Master is a miniaturization system providing *individual* negatives that meet archival requirements. Each negative is kept in its own 5" by 8" envelope. There is ample space on the envelope for large, legible identification coding and other information. Over 12,000 drawings can be stored in a standard 5" by 8" card file cabinet. No complicated cross-indexing is needed, for negatives of original drawings and all subsequent revisions can be grouped in the same file, ready for immediate reference. The absence of sorting devices eliminates scratches and other film damage resulting from excessive mechanical handling.

See Your K&E Dealer for Information, Equipment, Service

A camera, projector, three types of viewers, and all necessary printing accessories are available with the Micro-Master system, and all equipment can be obtained through your local K&E distributor. He can also furnish 105mm reductions and enlargements of your drawings as a service. For complete information, call your K&E dealer, or write to Keuffel & Esser Co., Dept. CE-5, 300 Adams St., Hoboken, N. J.

1934

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News of Engineers

(Continued from page 26)

Melvin F. Wood has been named chief engineer of the DuPont Company, Wilmington, Del. Mr. Wood joined the company in 1928 as assistant construction superintendent in the Engineering Department, and has been assistant chief engineer for the past thirteen years.

George M. Petzar, formerly of the Portland Cement Association's Los Angeles Office, is now district engineer of the new district office in Phoenix, Ariz. Mr. Petzar joined the Association in 1954 as a general field engineer, working in concrete and soil-cement paving, conservation and other fields of cement use. Since 1956 he has specialized in technical service in the field of housing.

Hugo Erickson recently resigned as city engineer of Minneapolis, Minn., after eleven years of service, to join Magney, Tusler and Setter, architectural and engineering firm, under its new name of Magney, Setter, Leach, Lindstrom and Erickson, Inc. Mr. Erickson will direct expanded engineering operations in the field of public works.

J. Donovan Jacobs, of Jacobs Associates, San Francisco construction engineers, has purchased the assets and practice of John C. Oglesby Engineering Company, Inc., specialists in surveying and field engineering in Marin County and Northern California. The new venture of Oglesby, Jacobs & Wickham will have offices in San Rafael. Mr. Jacobs will be president, **George E. Wickham,** vice president and resident manager of the San Rafael office, and **John C. Oglesby** will remain as a director.

Charles H. Lee, consulting engineer of San Francisco, has formed a partnership with **Michael Praszker,** his former chief engineer, under the firm name, Lee and Praszker, for the practice of soil mechanics foundation engineering and applied hydrology. The firm's offices and soil testing laboratory will remain at 58 Sutter Street, San Francisco, where Mr. Lee has maintained his headquarters since 1921.

Edward P. Albright has been named president and director of the Franki Foundation Company, New York, N. Y., the United States affiliate of Societe des Pieux Franki, Liege, Belgium, engineers and contractors for foundation work throughout the world. Mr. Albright was previously associated with MacLean-Grove & Company, Inc., and the Underpinning & Foundation Company, Inc.

Lewis Sterling Hedgpeth, district engineer for the U. S. Bureau of Public Roads, recently completed a two-year tour of duty with the Bureau's Liberian District and has been transferred to the International Cooperation Administration. He has been assigned to Indonesia on a comprehensive road building and rehabilitation program with responsibility for the development of training programs for Indonesian highway engineers and technicians.

Emilio Rosenblueth, until recently research professor at the University of Mexico's Institute of Engineering, has been made director of the Institute, succeeding **Fernando Hiriart.** Mr. Hiriart left to become subdirector of the Mexican Federal Commission of Electricity.

Odd Albert, consulting engineer of Belmar, N. J., recently returned from a visit to Sweden. While there, he spoke at the annual meeting of Tekniska Samfundet (Technical Society) in Gothenburg, on American methods of highway bridge design. He was also there in his capacity as chairman for the New Jersey Committee on Civilian Defense, to inspect and report on Swedish Defense Shelters.

Alton H. Peterson has been appointed construction engineer for the U. S. Bureau of Reclamation's Vernal (Utah) Unit of the Central Utah Project. Mr. Peterson has recently served as resident engineer in charge of the construction of Wanship Dam, the Wanship and Gateway Powerplants, and related facilities on the Weber Basin Project.

Herbert L. Munzel announces the opening of an office at 116 S. Lafayette Street, South Lyon, Mich., for the practice of civil engineering and land surveying. Until recently he was civil engineer with Neree D. Alix at Royal Oak, Mich.

NEW FAIRCHILD NAVIGATIONAL AID–Doppler Radar–can cut aerial survey costs, and time, in half!

Much of the cost of surveying desert, jungle and other featureless terrain lies in the expense of establishing ground stations or obtaining aerial photography necessary for accurate flight path control.

The Doppler Radar Navigational Aid, now available to Fairchild clients, automatically and continuously determines ground speed and drift angle of the aircraft. From this information an electronic "brain" in the aircraft computes its exact position, enabling the pilot to fly precise flight paths over any terrain without maps, photos, or ground control. This enables flying to be started faster and the survey to be completed sooner, resulting in important savings – as much as 50% on some projects.

Use of the Doppler Radar also makes possible the surveying of areas where maps are non-existent or unavailable.

This new Fairchild service is available for magnetometer and photomapping projects anywhere in the world. For complete information write or TWX:

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AERIAL SURVEYS, INC.
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Non-ASCE Meetings

Air Pollution Control Association. Annual meeting at the Hotel Statler in Los Angeles, Calif., June 22-26. For details write Harry M. Pier, Executive Secretary, Air Pollution Control Association, 4400 Fifth Avenue, Pittsburgh 13, Pa.

American Association of Cost Engineers. Third annual meeting at Carnegie Institute of Technology in Pittsburgh, Pa., June 22-26. Additional information from J. F. Lovett, Convention Publicity Chairman, Pittsburgh Coke and Chemical Company, 1970 Grant Building, Pittsburgh 19, Pa.

American Institute of Chemical Engineers. Fortieth national meeting at the Muehlebach Hotel in Kansas City, Mo., May 17-20. Information available from Raymond C. Mayer & Associates, 51 East 42nd Street, New York 17, N. Y.

American Institute of Electrical Engineers. Summer and Pacific General Meeting in conjunction with the Air Transport Conference at the Olympia Hotel in Seattle, Wash., June 21-26. For further information write to Raymond C. Mayer & Associates, 51 East 42nd Street, New York 17, N. Y.

American Society for Engineering Education. Conference and symposium on Applications of Economic Evaluation in Industry co-sponsored by the Engineering Economy Division of ASEE and the Engineering Economy Research Committee of AIIE at Carnegie Institute of Technology and the University of Pittsburgh in Pittsburgh June 13-14. The registration fee is $25 with a special rate of $5 for academic personnel. Registrations and requests for further information should be sent to Markwick K. Smith, American Telephone and Telegraph Company, Room 1104, 195 Broadway, New York 7, N. Y.

American Society of Mechanical Engineers. Fourth Annual Design Engineering Conference sponsored by the machine design division of ASME and the Design Engineering Show produced by Clapp & Poliak, Inc., at Convention Hall, Philadelphia, Pa., May 25-28. Information about the conference, hotels and advance registrations is available from Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, N. Y.

American Society for Testing Materials. The first in a series of forums to discuss the Standardization of Requirements for Engineering Materials Used in Nuclear Reactors will be held in Haddon Hall, Atlantic City, N. J., at 2 p.m. on June 25. Inquiries should be sent to ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Society for Testing Materials—American Society for Engineering Education. Jointly sponsored symposium on Education in Materials at the ASTM annual meeting in Atlantic City, N. J., June 22-26. Information available from ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Water Works Association. Annual Conference in San Francisco, Calif., July 12-17. Address queries to: AWWA, 521 Fifth Avenue, New York 17, N. Y.

Concrete Reinforcing Steel Institute. Annual meeting at the Greenbrier Hotel in White Sulphur Springs, W. Va., May 25-30. Additional information may be obtained from H. C. Delzell, Managing Director, Concrete Reinforcing Steel Institute, 38 South Dearborn Street, Chicago 3, Ill.

Instrument Society of America. Fifth annual symposium on Instrumental Methods of Analysis at the Shamrock-Hilton Hotel in Houston, Tex., May 18-29. Write ISA, 313 Sixth Avenue, Pittsburgh 22, Pa.

Maryland-Delaware Water and Sewage Association. Thirty-second annual meeting at the Commander Hotel in Ocean City, Md., June 3-5. Address requests for information to W. McLean Bingley, Secretary-Treasurer, Maryland-Delaware Water and Sewage Association, 2411 N. Charles Street, Baltimore 18, Md.

National Society of Professional Engineers. 1959 Engineering Progress Exposition co-sponsored with its New York State Chapter at the Hotel Commodore in New York City, June 17-20. Contact David J. Jacobson, United Public Relations, Inc. 120 East 56th Stret, New York 22, N. Y.

Ontario Water Resources Commission. Sixth Industrial Waste Conference at Delawana Inn, Honey Harbour, Ontario, June 15-17. Registration will be on June 14. Information from D. S. Caverly, Conference Secretary, Ontario Water Resources Commission, East Block, Parliament Buildings, Toronto, Canada.

Society of American Military Engineers. Thirty-ninth annual meeting in Washington, D. C., May 18-19. For details write SAME, 808 Mills Building, Washington, D. C.

Society for Experimental Stress Analysis. 1959 Spring meeting and exhibition on Experimental Techniques applied to Missile Structures and Space Vehicles at the Sheraton Park Hotel, Washington, D. C., May 20-22. Information from Robert O. Belsheim, General Chairman, 2475 Virginia Avenue, N. W.—Apt. 514, Washington 7, D. C.

Society of Naval Architects and Marine Engineers. 1959 Spring meeting on the St. Lawrence Seaway aboard the S. S. Tadoussac sailing from Montreal, Canada, June 12-15. Registration forms and additional information available from the Society of Naval Architects and Marine Engineers, 74 Trinity Place, New York 6, N. Y.

United Nations Educational, Scientific and Cultural Organization. Conference on Electronic Computers and New Science of 'Information Processing' in Paris, June 15-20. Information available from United Nations, Office of Public Information, United Nations, N. Y.

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These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which cooperates with the national societies of Civil, Electrical, Mechanical, Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a non-profit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 percent of the first year's salary if a non-member, or 4 percent if a member. Also, that you will agree to sign our placement fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include 8 cents in stamps for forwarding application to the employer and for returning when possible.

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Men Available

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., 39; professional engineer, New York, Wisconsin, Louisiana. Construction superintendent (last project budgeted at 30 million dollars)—pilot license; has held positions as resident engineer and director of public works. Desires position with opportunity in management or administration, permanent location. Prefer overseas or Northeast, Midwest or western United States. C-416-307-San Francisco.

EXECUTIVE ENGINEER, A.M. ASCE, B.C.E., 38. Five years' administration of construction and engineering contracts in building and engineered construction. Three years of design of structures and facilities. Background as engineer and owner and contractor representative in supervision and negotiation. Possesses business judgement and ability to set up operating methods. Licensed, New York State. Location desired: Eastern U.S. C-446.

CIVIL ENGINEER, M. ASCE, Registered P.E. in Pennsylvania. Twenty years experience in design and construction of buildings. Desires position as resident engineer to represent architect or owner on outside building construction. Location preferred: Pennsylvania, New York, New Jersey. C-447.

JUNIOR CIVIL ENGINEER, J.M. ASCE, A.B., B.S.C.E., 24. Ten months experience in construction of low rent housing projects, acting as supervisor for the owner—soil sampling; pile driving; concrete, steel and form work. Location desired: Eastern states. C-448.

CIVIL ENGINEER, J.M. ASCE, B.S.C.E., 25. Two years with consultant in sanitary field, drafting, surveying, design, estimates and studies. Two and a half years experience in high order surveying, levels, triangulation, and photogrammetry. Last year as chief of party of large survey party, handling accounts, personnel relations, estimates and computations. Location desired: East, Midwest, or South. C-449.

PROFESSIONAL ENGINEER, M. ASCE, registered in New Jersey, Connecticut, Georgia, Kansas, 54. Over twenty-five years experience in design and construction of airfields and related facilities, highways, flood control works and municipal engineering. Accustomed to directing large-scale engineering and construction programs in this country and abroad. Prefers Southwest but will consider long term engagement in other sections of U.S. or abroad. C-450.

CIVIL ENGINEER, A.M. ASCE, Argentine University degree, 27. Five years experience as engineer in charge of construction of four million—cu yd earth dam, spillway and outlet tunnel in South America. Desires position with consulting engineers firm or general contractor of huge hydro projects anywhere in the U.S. or abroad with salary in U.S. currency. Executive abiliay. Knows English and Spanish perfectly. Will be in New York in second half of August for personal interviews. Presently located in Argentina. C-451.

PROFESSOR OF CIVIL OR ARCHITECTURAL ENGINEERING, M. ASCE, M.S. in C.E., B. Arch. Nine years construction engineering, five years architectural and engineering practice, thirteen years teaching. Desires teaching position in cold climate of New England, Mountain or Pacific Northwest states C-452-945-Chicago.

ESTIMATE, DESIGN, PROJECT ENGINEER-CONTRACT, CONSULT; one and a half years—estimating earthwork, concrete, drainage, remodeling, new building for contractors. Two years—design and drafting on airports, buildings, for architect. Location desired: San Francisco Bay area. M-1513.

ESTIMATOR, PROJECT ENGINEER-CONSTRUCTION, CONTRACTING; C.E., 38. Eight and a half years—estimating, subcontract evaluation, expediting, field engineer for general contractors, sewage, fuel storage, pipelines. Two years—plans, specifications, supervise construction of sewage collection systems, buildings; consultants. Location desired: San Francisco Bay area. M-1586.

GEOLOGIST, HYDROLOGIST-CONSULTANT, WATER SUPPLY, RESEARCH AND DEVELOPMENT, M.S. Geology, 32. Three years of geological engineering, investigations on geohydrologic aspects of plant site selection, wastes, evaluation; atomic energy; three and one half years as geologist for water resources; one year as research assistant on geological investigations of well samples, earth resistivity surveys; three months as research assistant, refraction seismic studies for engineering and ground-water purposes. Location desired: East, Any. M-1454.

CIVIL ENGINEER-ARCHITECT, A.M. ASCE, AIA, C.E., California Registration, 46. Eleven years' civil, nine years' structural, five years' architect. Design and administrative experience on roads, railroads, dams, water aqueduct, steel mill, multi-story, buildings, offices, hospitals, and schools. Will fit into any position, private or public works. Prefer California or Midwest. M-950.

DESIGN, CONSTRUCTION-HYDRAULIC, IRRIGATION, MILITARY CONSTRUCTION, C.E., 30. Two years on structural and hydraulic design of new and relocated irrigation and drainage structures, levee construction, pumping plants, related structures; three years design irrigation projects; two years on supervision and administration military construction contracts. Location desired: western U.S. or Foreign. M-1386.

CIVIL ENGINEER, J.M. ASCE, B.S.C.E., B.S. Business, 26. Three years' service in U.S. Navy as a line officer in field of navigation and communications. Experienced in polar shipping operations. EIT-Colorado. Location desired: West. M-1234.

ADMINISTRATION, SUPERINTENDENT, RESEARCH and DEVELOPMENT-CONTRACTING, CONSTRUCTION, C.E., California license 50. Three years supervising structural engineering, review, check approve plans, specifications for schools submitted by architects, structural engineers, state. Two years in charge of construction of cement plant for United Nations. Nine years as Commander, Navy, Public Works Officer. Four years as project engineer in charge of all field engineering for pilot plant, chemical plant, power plant, utilities; construction company. Location desired: San Francisco Bay area. M-1496.

PROJECT, CHIEF, INSTRUCTOR-CONSTRUCTION, A.M. ASCE, M.S.C.E., 46. Two years as project engineer architect engineer services, design, costs, reports, drawings, specifications; runway extension, aircraft parking; buildings, laboratory, utilities. U.S. Navy (Capt. retired) C.E.C., supervisory, management of Navy construction program and maintenance public works, utilities. Location desired: West, Southern U.S., Foreign. M-1414.

CONSTRUCTION ENGINEER, M. ASCE, Projects 59. Resident engineer and project engineer with thirty years experience, structures, mechanical, electrical, sanitary water systems, pavements, streets, airports, administration, design, specifications, cost estimates, budget estimates, and general supervision of projects. Location desired: U.S.A. or Foreign. C-455.

MANANGER OR ENGINEER, M. ASCE, M.I.T.-U.V.M., 55. Twenty years experience on all types of concrete construction plus two years as manager of readymix plant. Registered P.E. in Illinois and Connecticut. Speaks Spanish. Seeks challenging management anywhere. Location desired: Midwest, or New England. C-456-947-Chicago.

Positions Available

ASSISTANT CITY ENGINEER, degree in civil engineering; licensed N.J. Professional Engineer and land surveyor or ability to qualify for same with five years experience in municipal engineering work, including one or more in a responsible supervisory capacity; some experience with building codes, zoning ordinances; and a through knowledge of modern engineering practices and procedures in the field of public works maintenance and construction. Will assist city engineer in the supervision of all activities in department of public works, including engineering division, building division, street and sewer division, etc. Apply by letter giving full details including salary requirements. Location: northern New Jersey. W-6356.

STRUCTURAL ENGINEER, civil graduate, with about ten years design experience covering industrial buildings and considerable power plants. Salary $10,000-$12,000 a year. Location, New York, N.Y. W-7025.

SALES ENGINEER, preferably civil engineering degree, with experience in concrete construction and sales of building materials. Salary $6,000 a year, plus bonus. Location: New York, N. Y. W-7071.

SENIOR BUILDING CONSTRUCTION ENGINEER, registered architect or professional engineer in New York State and two years' engineering or architectural field experience in the supervision of building construction projects. Duties will include inspection of building construction projects and maintenance programs; review of plans, specifications and estimates for building construction and assistance in budget review of proposed capital construction projects. Salary to start, $7,500 a year. Location: upstate New York. W-7074.

ENGINEERING CONSTRUCTION MANAGER, SALES, to take complete charge of construction contracts, evaluate and determine type company should bid on and know market area in Central and South America for large engineering, architectural and construction company. Should know Spanish. Salary, $35,000 a year, plus bonus. Headquarters, either southwestern U.S. or Central America. W-7112.

SENIOR ESTIMATOR, civil graduate, with at least five years experience covering take-off, pricing and handling sub-contractors on general building construction projects ranging from $100,000 to $3,000,0000. Salary, $8,000-10,000 a year. Location: New Hampshire. W-7148.

PLANNING ENGINEERS. (*a*) Chief planning engineer, civil-hydraulic, experienced in water resource development multi-purpose structures; river basin total yield; flood control, municipal and industrial supply, irrigation and related subjects; economics water use. Salary, to $16,000 a year. (*b*) Planning engineer, civil-hydraulic, to coordinate reports on several adjoining river basins. Should have experience in total river basin water resource control and development. Salary, $12,000-$15,000 a year. (*c*) Planning engineer, civil-hydraulic, for river basin planning, to develop and review hydrology and hydraulic design, preliminary structural design, costs. Salary, $12,000-$15,000 a year. (*d*) Planning specialist, civil-hydraulic (or economic-geographer), to analyze potential water use of several river basins, develop economics of alternate uses of water. Salary, $12,000-$15,000 a year. (*e*) Hydrologists, for river basin yield and control studies. Salary, $9,000-$12,000 a year. (*f*) Project engineers, for report writing. River basin development plans. Salary, to $12,000 a year. Two to three years work. Federal service. Location: Southwest. W-7149.

ARCHITECTURAL ENGINEER, with eight to fifteen

years experience in industrial office, laboratory and factory. Must be registered. Salary open. Location: Midwest. W-7154.

PROFESSOR OR ASSOCIATE PROFESSOR in sanitary engineering. Will serve as President of the Department of Sanitary Engineering. Salary open. Location: Mediterranean area. F-7198.

CIVIL ENGINEER, graduate or equivalent, with experience in surveying and preparation of maps; to work in land department office of large industrial corporation. Location, Alabama. W-7232.

FIELD EDITOR, civil graduate, with construction experience, to do field work and prepare articles covering construction, materials and equipment. Considerable traveling. Salary, $6,000-$8,000 a year. Headquarters, New York, N. Y. W-7235.

SENIOR CIVIL ENGINEER, B.S. degree in engineering with six years experience in operation and maintenance of a sewage treatment plant or related engineering activities, three years of which shall have included management responsibility or any equivalent combination of education and experience. Location: Virginia. W-7239.

SALES ENGINEER, civil or architectural degree, with a minimum of two to three years sales experience in the construction field, for sale of floor and roof construction, highway, bridge decking, etc. Sell through distributors already established. Salary, $7,200-$7,800 a year, plus bonus and commission. Should reside in New York City area. Territory, New York, New England. W-7271.

MANAGER, graduate civil engineer, with ability to assume complete charge of activities for long standing clientele in specialized field for an engineering and surveying organization. Must be registered engineer in Pennsylvania. Expansion potential is excellent for engineer interested in partnership accrual through successful management or direct purchase. Location: Pennsylvania. W-7274

RESIDENT ENGINEER, civil graduate, with at least ten years supervisory industrial construction experience covering manufacturing plants and installation of equipment and facilities. Knowledge of Spanish desirable. Salary open. Location: Caribbean area. F-7279.

RESIDENT ENGINEER, graduate with about five years supervision of construction on water, sewerage, steam power and/or building construction, for established midwest consulting engineering firm. Location, generally midwest, but assignments may be to other areas of U.S. W-7289.

CIVIL ENGINEER, graduate, with from one to two years' experience, preferably in taking off quantities and materials from architectural and structural plan for large international contractor. Salary, to $5,370 a year. Location: southern New Jersey. W-7301.

OFFICE HYDROLOGIC ENGINEER, B.S.C.E., five years experience, two of the five years experience with USGS. Know steam gauging and hydrology. Duties: General office work on hydrology and planning of developments. Field work on steam gauging and steam flow determination. Considerable foreign travel for a consultant. Salary, $7,200-$10,200 a year. Employer will negotiate placement fee. Location: Chicago. C-7373.

ARCHITECT, college degree, with six to ten years experience in industrial architecture, eligible for registration in Minnesota. Duties: Architectural design supervision of preparation of working drawings. Capable of guiding others in architectural phases of completing construction projects, some travel. Member of Central Engineering Group, Construction Department of large industrial organization. Employer will pay placement fee. Salary, to $12,000 a year. Location: Minnesota. C-7388.

ESTIMATOR, take off-R/F rod: C.E. background, should be very good in taking off from plans and listing for bid purposes on R/F rod for steel fabrication shop. Must be fast and accurate in a busy plant. Salary about $6000 a year plus excellent and complete fringe benefits. Location: Monterey County, Calif. S-4199.

FIELD OFFICE ENGINEER, B.S.C.E., with some heavy concrete construction experience, qualified to estimate, design, layout and coordinate engineering with construction for general contractors. Salary, $7,800-$9,000 a year. Location: San Francisco Bay Area. S-4201.

ASSISTANT TO SUPERINTENDENT, Construction: C.E., recent graduate, to work for senior field engineer in keeping time and records on general construction job for a contracting firm. Good academic record and qualifications to advance to field and office type engineering and construction superintendent. Salary, $5,400 a year. Location: San Jose, Calif. S-4211.

DESIGNERS, structural: C.E. background, experience in engineering services-type work (engineering, design, layout or draft) on heavy concrete, R/S foundations and steel for steam or hydraulic power, process or plant installations; board men, engineers and supervisors. Salary commensurate with experience. Location: San Francisco East Bay. W-4223.

FIELD CONSTRUCTION SUPERINTENDENTS, general building: C.E. or equivalent, qualified by three to ten years general building experience in field and office to act as owner's representative for construction division; handle work schedules and progress, field changes, shop drawings, cost or bid estimates. Should know building designs, inspection, acceptance, alternates, modifications in contract administration with general or subcontractors, or architects in all constructive mechanical trades. To assist in successful completion of new or remodelled stores construction in Northern California, limited travel. Employer pays placement fee. Salary, $7,800-$9,600 a year. Headquarters, San Francisco. S-4231.

DESIGNER, concrete structure: C.E., well qualified and recent experience with design and board work, (foundations through complete structure and equipage) on slip form and general heavy concrete (foundation, retaining walls, storage-open and closed, processing areas) for bulk products (grain, raw food, quarry product, crushed rock, cement and other raw products) plus ability to handle some industrial construction, field work and materials expediting. For a long established engineering construction firm. Salary, to $8,400 a year. Location: San Francisco. S-4242.

ESTIMATOR, take off-heavy construction: C.E. or equivalent, minimum of five years experience estimating, taking off and preparing for bids on heavy highway construction, underground, streets, alleys, parking areas, largely grading, paving, earthmoving and surfacing. For contractor on jobs running up to $300,000 for airfields, municipalities or others. Must be able to provide guidance and instruction in estimating and bidding procedures for younger engineers. Salary, $6,600-$7,800 a year. Location: Sacramento. S-4245.

PROJECT ENGINEER, general construction: C.E. background, well experienced in running work crews, dealing with contractors and subcontractors in construction and mechanical trades on multi-dwelling buildings (concrete, steel, non-bearing partition). For an architectural, engineering, and construction firm providing packing deal for residence type construction. Salary, $8,400 a year. Location: San Francisco. S-4254.

Recent Books

(Continued from page 112)

Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1958. 790 pp., bound. $10.75.)

Stauanlagen Und Wasserkraftwerke

I. Teil: Talsperren

Part I of a three-volume set on hydroelectric power plants, this volume gives a concise but comprehensive description and analysis of the various types of modern concrete gravity, arch, and earth dams, with a wealth of illustrative sketches and photographs from existing installations. Auxiliary structures and equipment are also shown, and there is a bibliography of over 1200 items. Considerably enlarged from the previous edition. (By Heinrich Press. Second Edition. Wilhelm Ernst & Sohn, Berlin, Germany, 1958. 395 pp., bound. 54 DM.)

Uplift In Gravity Dams

Based upon a previously published paper by the author, this book represents a revision and expansion of the subject matter. Beginning with the earlier theories, the author then gives detailed consideration to recent theories such as those proposed by Fillunger and Terzaghi. He continues with a study of the experimentation now being conducted in this area and of the problems associated with it. The concluding section outlines structural methods used for reducing uplift pressure and leakage in dams, including screens, graduated concrete, earthen banks, various facings, and flat slabs. (By Serge Leliavsky. Frederick Ungar Publishing Company, 105 East 24th Street, New York, N.Y., 1958. 267 pp., bound. $9.50.)

HYDROLOGIC ENGINEER

Five to ten years experience; minimum two, preferably five with USGS. Considerable foreign travel. Salary open. Send complete personal and experience record to

Personnel Manager

HARZA ENGINEERING COMPANY

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Soils Dynamics

Senior staff opening exists for a high calibre man to act as project leader in the field of soils dynamics. This man will guide basic and applied research programs on soils in a completely newly equipped facility. Research will be in the areas of wave propagation in soils, soils properties, and soils structure.

This position requires a Ph.D. or equivalent and several years experience in this field. Preference will be given to the candidates with a record of publication. Creative ability and desire to use your initiative essential.

This is an opportunity to work with some of the leading engineers and scientists in a congenial atmosphere, conducive to creativity. Excellent employee benefits including liberal vacation policy. Please send resume to:

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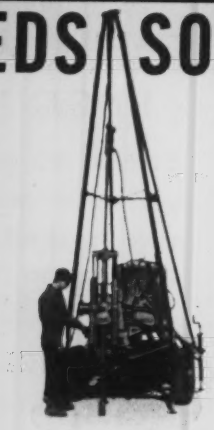

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Whatever the sampling technique, the Acker Teredo is up to it! Its modern design and host of useful features makes the Teredo the most useful you can buy!

It's ruggedly built, yet compact and light enough to be completely portable. Mount it on skid base, truck or trailer and power it with gasoline, diesel, electric or air motor. It's easy to use — inexpensive to operate!

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Over 40 years of experience manufacturing a complete line of diamond and shot core drills, accessories and equipment.

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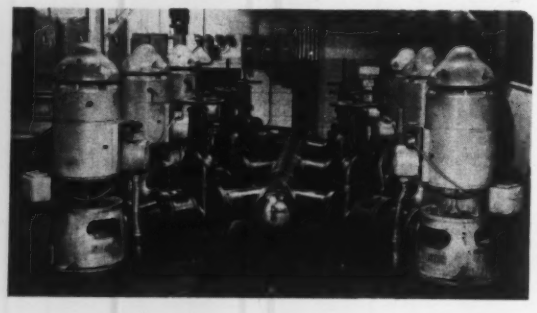

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You can put SIX vertical Johnstons in the same space needed for just TWO horizontals — and get 3 times the pumping capacity.

VERTICALS ARE VERSATILE, TOO: Primary water supply, sumps, pipe lines, refineries, condenser lines and boosters, circulating, dewatering, volatile fluids, cooling towers.

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New in Education

Summer Sessions . . . *Pennsylvania State University* offers a Plastics Engineering Seminar, June 28 to July 3, to help design engineers and those engaged in research on materials keep abreast of advances in the field of high polymers. Dr. L. W. Hu, associate professor of engineering mechanics, is coordinator of the seminar. Additional information is available from the Extension Conference Center, Pennsylvania State University, University Park, Pa. . . . The fundamentals of corrosion reactions and control will be given in an intermediate-level short course at *Massachusetts Institute of Technology*, June 22-26. The course is intended for those who have had short courses on the subject sponsored by the National Association of Corrosion Engineers or experience in the corrosion field. Additional information may be obtained from James M. Austin, Director of Summer Sessions, Massachusetts Institute of Technology, Cambridge 39, Mass. . . . It is now possible to attain a Master of Science degree in engineering through evening classes in Structural, Hydraulics and Civil Engineering at the *Arizona State University*. Civil Engineering is represented in this program by three graduate courses—City Planning, Hydraulics and Theory of Structures. . . . *Tufts University* offers its Fourth Annual Workshop in Technical Writing from July 6 to July 17. There are no formal prerequisites for admission. Inquiries should be addressed to James R. Strawbridge, Director, Tufts University Summer School, Medford 55, Mass. . . . A course in asphalt paving, designed for instructors in the field, is offered at *Cornell University*, beginning June 16. The program, supported by The Asphalt Institute, has sixteen $800 grants-in-aid available. Application should be made *as soon as possible* to Prof. Taylor D. Lewis, College of Engineering, Lincoln Hall, Cornell University. . . . *Columbia University's School of Library Service* offers a summer course in engineering literature and librarianship from July 6 to August 14. Admission is limited to persons with a bachelor's degree and adequate background in science or librarianship. For applications write the School of Library Service, Columbia University, New York 27, N. Y. . . . The *Massachusetts Institute of Technology* announces a two-week summer program on the shear strength of soils, to be given August 31 through September 11. The program is designed to provide practicing engineers, researchers, and educators with an up-to-date understanding of the fundamental nature and use of shear strength in engineering problems.

Urban studies center . . . A Joint Center for Urban Studies is being established by *Massachusetts Institute of Technology* and *Harvard University*. It will investigate basic facts in the tangled problems of big city growth in this country and abroad.

3 New International® Earthmovers

new CAPACITIES (24 yd. scrapers, 27 yd. wagon)

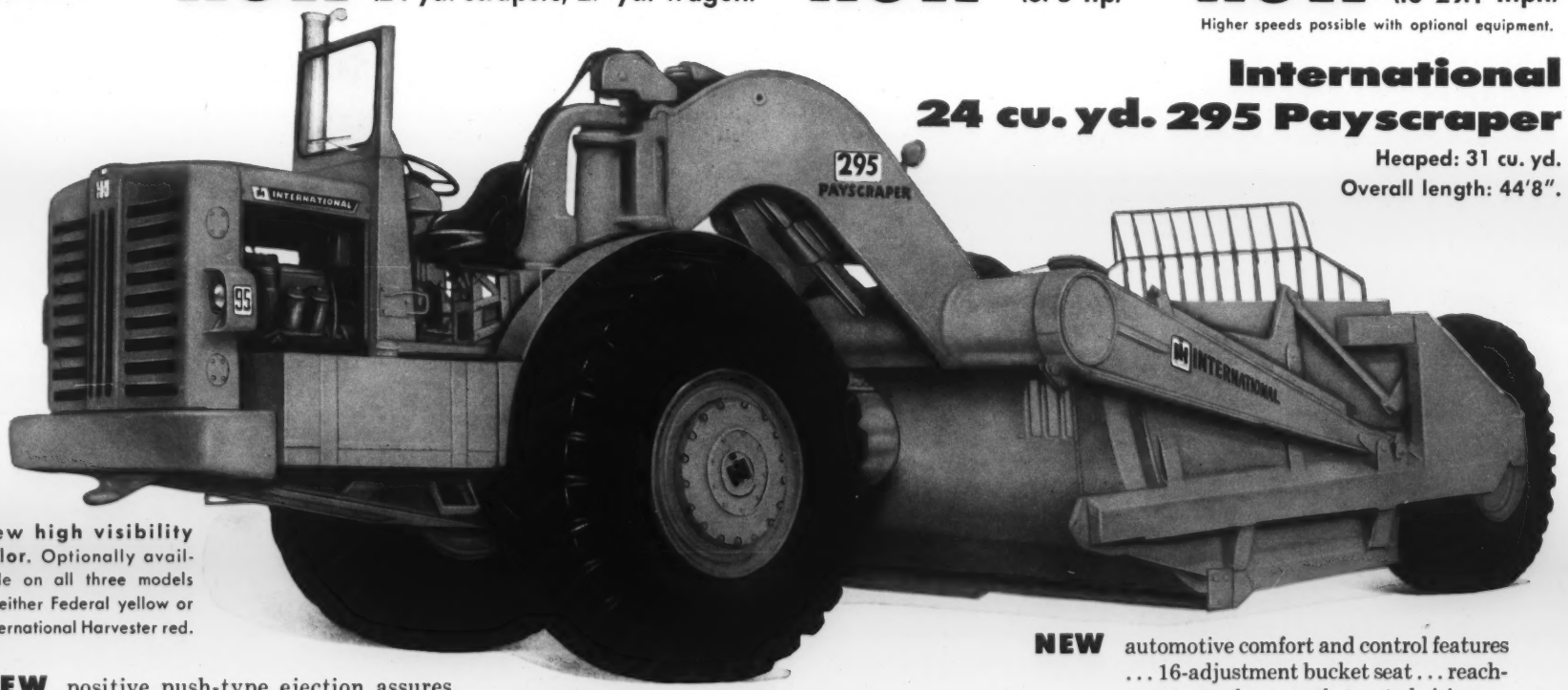
new POWER (375 hp)

new SPEEDS (to 29.1 mph)

Higher speeds possible with optional equipment.

International 24 cu. yd. 295 Payscraper

Heaped: 31 cu. yd.
Overall length: 44'8".



New high visibility color. Optionally available on all three models in either Federal yellow or International Harvester red.

NEW positive push-type ejection assures quick clean dumping of all materials.

NEW advanced lift frame construction with A-frame-type gooseneck that: 1) increases visibility; 2) distributes weight evenly along cross tube; and 3) protects sheaves of bowl lift system.

NEW full 90° turns with power steering.

NEW 375 hp DT-817 turbocharged 6-cylinder diesel engine. See page 4.

NEW cycle-shortening haul speeds to 26.2 mph plus unmatched maneuverability.

NEW exclusive tapered bowl. See next pages.

NEW high 98" apron opening. See pages 2-3.

NEW automotive comfort and control features . . . 16-adjustment bucket seat . . . reach-easy controls . . . unobstructed vision . . . air brakes . . . flush deck.

NEW Model 280 cable control unit . . . finger-tip control . . . fast acting . . . high capacity . . . simple adjustments . . . less maintenance.

See 3-axle models on inside pages...

27 cu. yd. International 495 Paywagon®

Heaped: 40.5 cu. yd.
Payload: 40.5 tons.
Overall length: 50'4½".

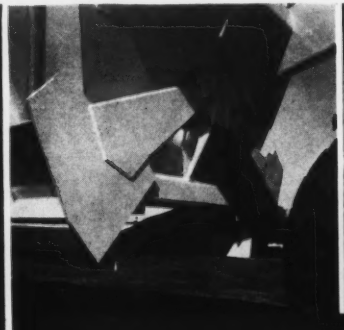
Here in the *27 cu. yd.* International 495 Paywagon is everything that's new and productively *different* in bottom dump design. New 375 hp engine for greater power *per struck yard than any comparable rig.* New higher side and rear end clearance to roll away from any dumped load. New power-opened clamshell doors for positive controlled dumping. New wiper plates put 100% of each load on the fill. New automotive comfort and control features *that* let the operator produce more with less effort. New full 90° turning in either direction. New low design for haul road stability.

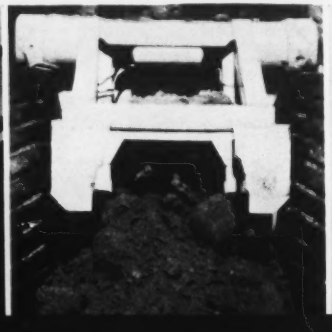
New exclusive power-opened clamshell doors afford positive controlled dumping. Operator spot dumps entire load or windrows material in lifts from a few inches on up. Wiper plates shave all material from doors as they raise. Doors gravity close, eliminating complicated mechanism.

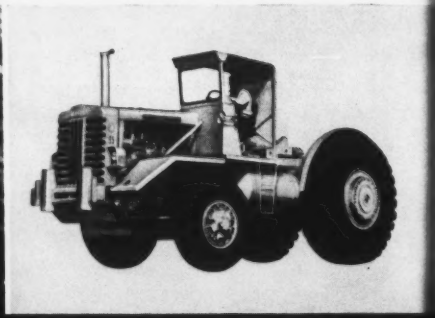
Unmatched 60" rear end dumping clearance lets rig pull fast from fill with no dangling doors dragging on dumped material. Open rear frame lets loader spillage fall through — prevents buildup of "free loading" material.

375 HP 495 prime mover gives both 495 Paywagon and 495 Payscraper more hp per struck yard with less gross weight per hp than any similar sized earth mover. Speeds to 29.1 mph. 10'8¼" wheel base. Full 180° non-stop turns can be made within 39'11¾".

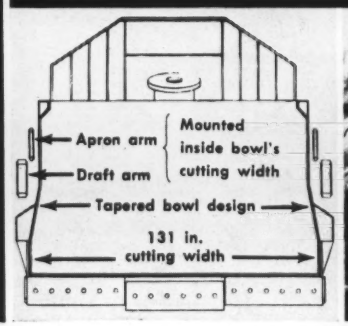
NEW
high speeds
big capacities

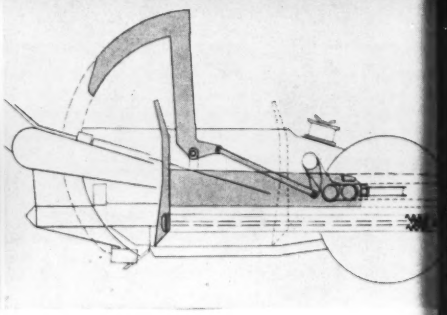






fast dumping
unmatched control





This new International 495 Payscraper boils a heaped load into a 24 cu. yd. bowl in less time than any other three-axle scraper in its class and hauls it at speeds up to 29.1 mph. The trailing unit, common to the 295 Payscraper, offers this unmatched combination of features that cut dirt costs: big 131-in. cutting width . . . tapered bowl permits efficient ejection of all materials with equal ease . . . positive forced ejection . . . improved lift frame construction . . . full 90° turns . . . more hp per struck yard than all competitive units . . . wheels and bowl leveling adjustment . . . advanced sheave bearing design . . . and custom designed cable control unit.

Exclusive tapered bowl design: 1) permits scraper and pusher to work inside cut for best traction, less wear on tires, and tracks; 2) causes dirt to boil toward center, reducing side spillage; 3) extra wide bowl bottom provides wider spread, speeds dirt breakaway and lets scraper work cuts against banks.

Positive forced ejection dumps all materials — even wet or frozen clay and gumbo — cleanly and quickly. Six large ball bearing mounted rollers center and guide ejector gate, have 240-hour lube intervals.

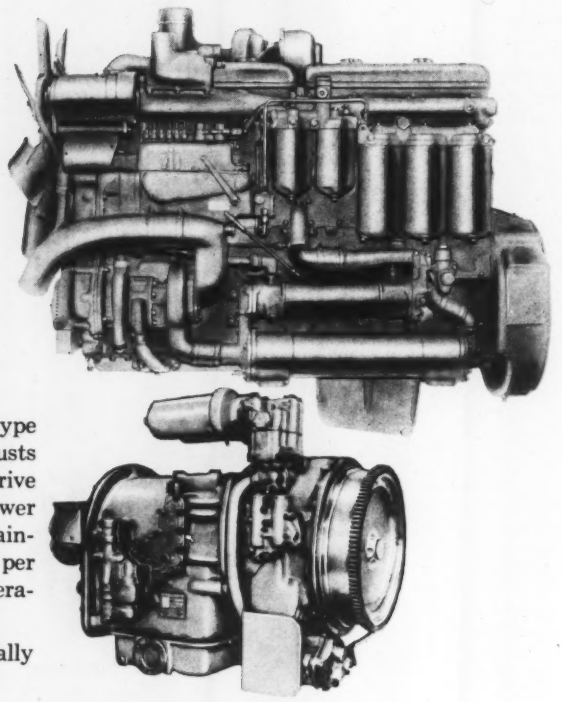
Gaping 98" apron opening plus no bowl cross member permits sure ejection of all materials. Apron opened by exclusive, rear-controlled mechanical linkage. Apron is synchronized with ejector for positive controlled spreading.

24 CU. YD. International 495 Payscraper

Heaped: 31 cu. yd.
Overall length: 50'6¼".

New Turbocharged International DT-817 powers all three giant earthmovers

- Develops 375 hp @ 2100 rpm
- Direct push-button, 24-volt starting
- Positive valve rotators — increase valve life
- Aluminum alloy pistons for fast heat dissipation
- Wet sleeve construction provides additional cooling
- Fully counterbalanced crankshaft for smooth engine performance
- Dual intake and exhaust valves for peak engine efficiency
- Twin plunger injection pump precision meters fuel
- Hang down type replaceable filters for maximum fuel and oil filtering efficiency
- Tri-metal crankshaft bearings for long trouble-free service



Both prime movers are available with 4-speed, planetary type torque converter power shift transmission. It automatically adjusts output torque and speed to fit load requirements. Torqmatic drive makes more power available over the entire range; applies power smoothly and continuously, resulting in less wheel slippage; maintains high tractive effort; and cuts the number of gear shifts per cycle, letting operator concentrate on loading and spreading operations.

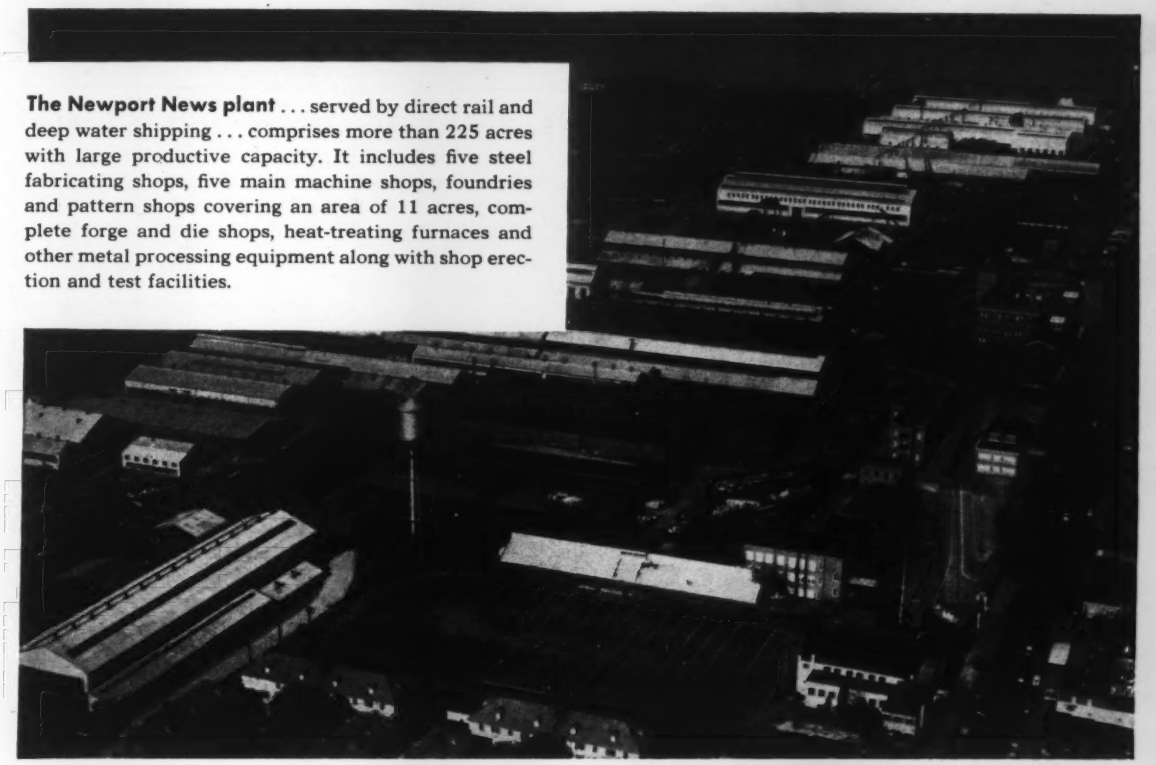
A constant mesh 9-speed manual shift transmission is optionally available on both prime movers.

See your International Construction Equipment Distributor for complete information on these NEW International Earthmovers

International® *Construction Equipment*

International Harvester Co. • 180 N. Michigan Ave., • Chicago 1, Ill.

A COMPLETE POWER PACKAGE: Crawler and Wheeler Tractors . . . Self-Propelled Scrapers and Bottom Dump Wagons . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.



The Newport News plant . . . served by direct rail and deep water shipping . . . comprises more than 225 acres with large productive capacity. It includes five steel fabricating shops, five main machine shops, foundries and pattern shops covering an area of 11 acres, complete forge and die shops, heat-treating furnaces and other metal processing equipment along with shop erection and test facilities.

Make Newport News your source for fabricated metal structures

Let Newport News fabricate your weldments or sub-assemblies. Call on us for plate fabrication . . . from vacuum tanks to bridge caissons . . . for pumps, valves, pipe lines . . . you'll find that Newport News fabricates parts to answer most demands.

In the vast plant, shown above, Newport News craftsmen complete your orders with specialized production techniques, and with sound experience acquired through construction of thousands of products ranging from small components on rayon spinning machines, to the giant 165,000 hp hydraulic turbines at Grand Coulee.

See for yourself what Newport News is doing, and how this company's high integration of skill and production facilities can help you. Get the facts, shown in *Facilities and Products.* A copy of this illustrated booklet is yours for the asking . . . write for it now.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

Jet-Airport Sweeper

A NEW HIGH-SPEED VACUUMATIC jet-airport sweeper which can clean 2,000,000 sq ft of runway space per hour has been introduced.

Said to be the most powerful sweeper ever built, the "Jet Vac-Matic Airport Cleaner" is designed primarily to meet the more exacting cleaning requirements of airports where jet planes are used. It can pick up house bricks at 32 miles per hour with a 12-ft swath.

In tests recently conducted by American Airlines at Chicago's Midway Airport, the new cleaner successfully picked

Cleans 2,000,000 Sq Ft Per Hour

up sand, gravel, stone, bolts, nails, metal rods, pop bottles, and wrenches—all purposely strewn over a chalk-marked test area.

The new cleaner is 12 ft 3 in. high, 8½ ft wide and approximately 33 ft long. It is mounted on a standard truck chassis (Ford C-900) with an extended, self-enclosed frame.

It develops its powerful suction—a 65,000-cu-ft-per-min vacuum system and 130-mi-per-hour jet stream—through a direct-drive vacuum system powered by a 385-hp Hercules Hall-Scott gasoline engine. **Sabre Metal Products, Inc., CE-5, 8000 West 47 St., Lyons, Ill.**

Silver-Zinc Batteries

MAN'S FIRST WEATHER OBSERVATION SATELLITE, now circling the earth, was shot into orbit with the help of small, compact power packs that are becoming the "space batteries" of the future.

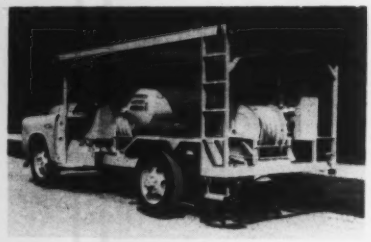
Tiny, powerful silver-zinc batteries called Silvercels provided the electric power for telemetering and flight and guidance controls in the first and second stages of the three-stage, 72-ft Vanguard rocket.

Only one-sixth the weight and one-fifth the size of ordinary batteries, they performed the same telemetering-flight-guidance functions in the launching of the first Vanguard satellite, which is expected to stay in orbit another 200 years.

Silvercels were also used in a number of other space programs, including the Pioneer space probes, where they powered the satellite's television camera, instrumentation and telemetering, as well as telemetering and flight and guidance controls in the second stage. In the 4½-ton Atlas satellite, Silvercel batteries were used for main power and range safety. **Yardney Electric Corp., CE-5, 40-50 Leonard St., New York City, N. Y.**

Airport Servicer

A MICRONIC FILTER-WATER SEPARATOR, positive displacement meter, valving hydrant hose and coupler and the aircraft fueling hoses and nozzles, are included in the Aviation Gasoline Hydrant



Automatic Shutdown

Refueling Servicer. Provision is made for automatic shutdown in the event of water in the filter-water separator sump.

The meter is equipped with both a ticket printer, enclosed in a sheet metal housing, and an explosion proof light for night-time refueling.

The top deck has a hinged refueling ladder for overwing fueling and a 50 ft length of 2-in. hose. The rear hose reel also holds 50 ft of 2-in. hose for underwing (pressure) refueling.

The capacity of the unit is 250 gpm with aviation gasoline or 150 gpm with aviation kerosene.

Two automatic rewind static grounding cable reels are used for grounding to aircraft and to ground. Two 20-lb dry chemical fire extinguishers are provided at convenient locations. **Garsite Products, Inc., CE-5, 4045 Merrick Road, Seaford, L. I., New York.**

New Cabs

FIVE NEW CABS DESIGNED expressly for the newest Caterpillar wheel-type Tractors are now being offered. Both standard and heavy duty cabs are available for the DW20 and DW21—the standard is built from 12 and 16-gauge material, while the "Super" has many heavier sections including ¼-in. steel plate roof and 3/16-in. rear panel for extra protection from falling objects. These cabs are of a design, quality and workmanship to equal the tractors with which they are used.

All cabs have shatter-proof glass windows, which are designed to provide maximum visibility. Windshields have reverse slopes to minimize dust collection on glass and doors have roll down windows and no-draft ventilators. The cabs are engineered to be installed or removed quickly from the tractor. **Crenlo, Inc., CE-5, River Rd., Rochester, Minn.**

Sprayed-On Fire Protection

CELLULAR STEEL FLOORS AND BEAMS protected with Sprayed "Limpet" Asbestos now boast a fire rating of 4 hours. Steel columns, depending upon the thickness of the asbestos coating, are now rated at 2, 3 and 5 hours.

The tests resulting in the new ratings, were conducted in strict accordance with ASTM Specification E119-55 and under the observation of a representative of the Underwriters' Laboratories. There were two separate tests during which the asbestos was subjected to gas flames which reached 2000-deg F at the end of 4 hours.

Standard cellular steel floor units 3-in.

No Primary Adhesive Required

deep, with a 2½-in. concrete fill, were used for the test. The asbestos fiber filled the corrugations and provided a ½-in. minimum thickness below the steel.

The steel beam was encased with metal lath on wire brackets. The Sprayed "Limpet" Asbestos provided a 1¼-in. thickness at the sides with a thickness of 1½-in. at the bottom.

Steel columns carry ratings of 2, 3, and 5 hours when protected with a minimum of 1½, 2 and 3 in. of the asbestos, sprayed directly onto the steel surface, with an average thickness of not more than 12% above minimum. No primary adhesive was required in any of the applications. **Keasbey & Mattison Co., CE-5, 1958 Butler Ave., Ambler, Pa.**

Coal-tar sealer helps airports prepare for the jet age

The photo at left dramatically illustrates the purpose of Koppers Pavement Sealer. Applied by spreader-box at a 5 to 8 mph pace, this tar-based emulsion protects and seals weathered asphalt surfaces, preventing further deterioration and permitting jet operation without recurring intake hazards.

The coal-tar base of Koppers Pavement Sealer is impervious to fuel spillage, too. That's why so many airports have used it on parking and maintenance areas as well as for the protection of runways.

Other advantages to Koppers Pavement Sealer: it requires no heating; sand filler (for traction) can be transit-mixed; average drying time is only 2 hours—complete curing in 12 to 24 hours; and cost/sq. ft. is surprisingly low.

Of course, Pavement Sealer cannot repair badly deteriorated bases: the best solution there is to re-pave with tar concrete and *then* seal the surface. If you'd like to know more about costs and other specifics on airport runway sealing—or about other applications for Koppers Pavement Sealer—use the coupon below.

KOPPERS®

PAVEMENT SEALER

another fine product of COAL TAR

Koppers Company, Inc.
Tar Products Division
Dept. TPS
Pittsburgh 19, Pa.

I'd like more information on Koppers Pavement Sealer for
☐ airports ☐ resealing asphalt pavements elsewhere.

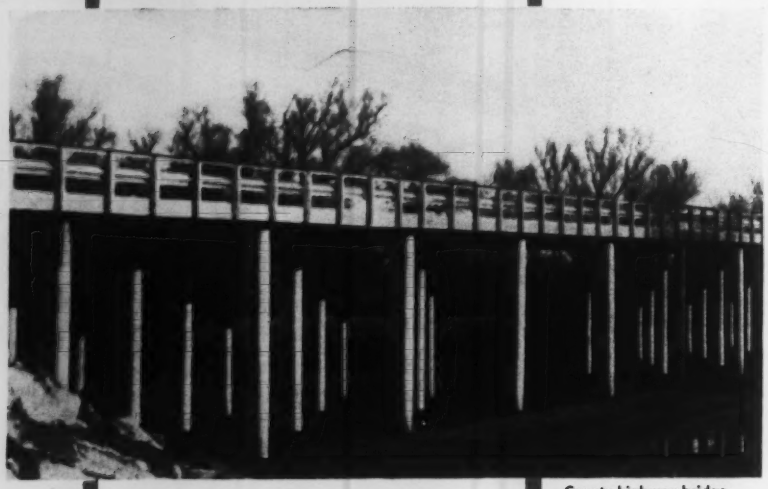
Name_____

Firm_____

Address_____

City_____ Zone____ State_____

SPEED CONSTRUCTION OF ROUND CONCRETE COLUMNS



County highway bridge, Galt, California. Designed by California Division of Highways. Thomas Construction Co., Sacramento, contractors.

Use low-cost, time-saving

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Sonotube.®
FIBRE FORMS

Approved by engineers and architects, and used by contractors everywhere, SONOTUBE Fibre Forms provide the fastest, most economical method of forming round columns of concrete.

The forest of columns supporting the bridge shown above were formed with 2000 feet of 16" I.D. Sonotube Fibre Forms.

Low-cost Sonoco SONOTUBE Fibre Forms are designed for use wherever round concrete columns are to be formed . . . in buildings, schools, churches, parking garages, bridges, overpasses, many other structures . . . and save time, labor and money!

Choose from 3 types: Seamless (premium form for finished columns), "A" Coated (standard form for exposed columns), or "W" Coated (for unexposed columns).

Sonoco SONOTUBE Fibre Forms are available in sizes from 2" to 48" I.D. Order in specified lengths or standard 18' shipping lengths. Can be sawed to size on the job.

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EQUIPMENT MATERIALS and METHODS

(continued)

New Power Graders

FIRST TO APPEAR IN THE Austin-Western new equipment line-up are two all wheel drive and steer power graders, the Pacer-200, a 4-wheel drive machine, and the Super-200, a 6-wheel drive model. Both machines have a basic weight of 20,000 lb.

Front and rear power steering and full hydraulic control are standard features of the machines. They are equipped with 106-hp GMC diesel engines and power train options permit a choice of dry

Super-200

clutch or torque converter and either 4-speed or 6-speed transmissions. A hydraulically operated power-tilt mold board is an optional feature.

The 200-series machines for the first time give the company a power grader in the 20,000 lb weight class. Previously, they offered both heavier and lighter graders but none in this weight class, now frequently specified in many road-building contracts let by governmental and military agencies. **Austin-Western Construction Equipment Div., Baldwin-Lima-Hamilton Corp., CE-5, 1952 Barrows St., Aurora, Ill.**

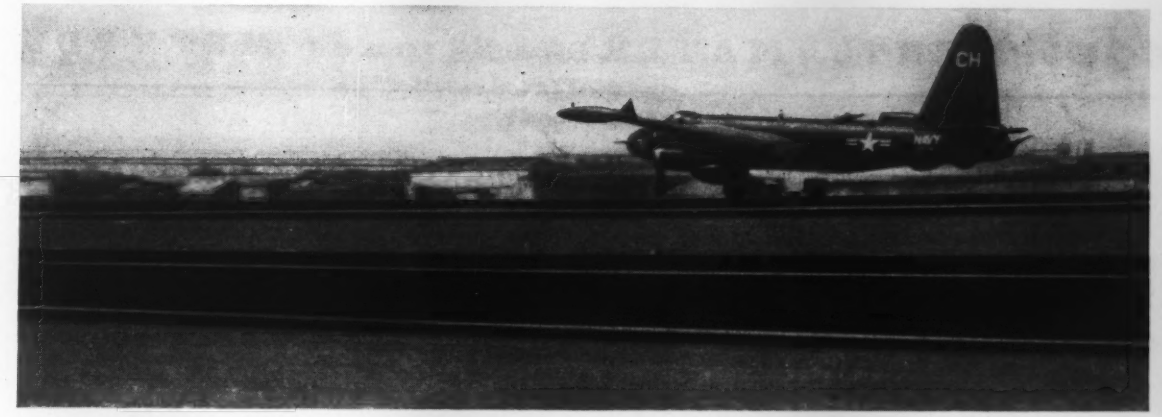
Optical Measuring Instruments

AFTER AN ABSENCE FROM the American market for a number of years the Carl Zeiss-Jena Optical Measuring Instruments have been made available again.

They include such items as Toolmaker Microscope with 6 in. by 2 in. range and Universal Measuring Microscope with 4 in. by 8 in. range, used for checking of cutting tools, control of gages, thread measurements and Precision Measuring of jigs, fixtures and extremely accurate work.

Of special interest will be the Length Measuring Machine for external and internal measurements, which uses a

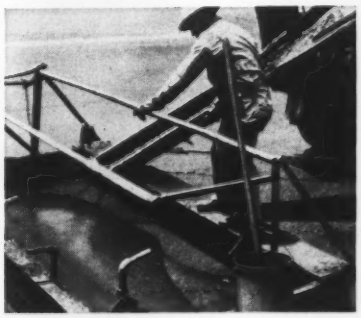
(Continued on page 132)



Navy gets double savings with Bitumuls Slurry Sealing of Runways at Jet Training Station

ONE of the busiest military air installations on the entire West Coast is the Alameda Naval Air Station. In addition to heavy traffic in propeller-driven aircraft, Alameda is an important West Coast jet aircraft training center.

Runway Construction—The runways of this Naval Air Station are surfaced with asphaltic concrete, placed over a 6″ course of Bitumuls Sand Mix. The wide shoulders adjacent to these runways are also Bitumuls RS-1 Chip Seal. The surfacing was placed some four years ago, and recently showed signs of weathering. Close



Bitumuls Slurry is chuted into spreader-box as mix-truck travels at speeds up to 5 MPH.

inspection disclosed some ravelling; minor hair-cracks on the surface; and some loose material. This loose material, while of little importance during the days of conventional-type aircraft, had become a major source of expense after jets started operating here. Sand, small stones, and other loose material can cause considerable damage, when scooped into the jet engines.

A Dual Problem—The Navy was looking for answers to two problems: First, a method of revitalizing the runways and extending the life of the pavement surface. Second, a means of cutting down the repair bills involved when jet engines were damaged by loose material scooped up from the surface of the runways. *They found a single answer to both these problems in Bitumuls Slurry Seal!*

Bitumuls Slurry Seal composed of fine, sharp aggregate, Bitumuls Mixing Grade emulsified asphalt and water, was mixed in transit-mix trucks to a free-flowing, slurry consistency. It was applied by the squeegee action of a spreader-box to 350,000 sq. yards of runway and taxi-way. Contract for this work was awarded to George Reed, a contractor from Modesto, California.

To offset the high abrasive action of the aircraft tires on landing, a dilute (3 to 1) Bitumuls tack coat was placed ahead of the Slurry Seal to insure maximum adhesion.

Fast-Fast Application—It was "business-as-usual" at the Air Station while this work was in progress. In spite of the additional requirement of the tack coat, Bitumuls Slurry Sealing reduced interference with air traffic to a minimum. Planes at the Station were able to taxi over the fresh seal coat four hours after application. Jet aircraft landed on the new seal 24 hours after application.

The costs involved in providing this new life for the existing runway pavement was considerably less than that of a normal seal coat application.

"Meanwhile, at the Hangar..." In the repair shops, an extra "bonus" economy will be realized because Bitumuls Slurry Seal has eliminated loose material from the runways. *The cost of mechanical repairs occasioned by the induction of foreign material through the jet engines is expected to be sharply reduced.*

A Proved Procedure—Bitumuls® Slurry Seal has been proved on many installations—on highways, streets and airport runways—in terms of economy of initial application, and also in terms of durability. It can be applied in any quantity or volume for either construction or maintenance. Call our nearest office if you need additional information. It will be given gladly; and, of course, without obligation.

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(continued)

graduated glass scale and an optical lever for direct readings to .000050 in., having an outside measuring range of 40 in., 120 in., and 240 in. Other instruments, namely the vertical and the horizontal Metroscope employ precision glass scales, built in the measuring head or spindle respectively, which are read through a spiral micrometer microscope to 50 millionths of an inch. The Optimeter is using auto-collimation as basic principle, with an integral scale as measuring means. **George Scherr Co., Inc., CE-5, 200 Lafayette St., New York 12, N. Y.**

Contact Sheeting System

A NEW CONTACT SHEETING system for deep, tight excavations has been announced. This exclusive system can be used advantageously for all excavations where water can be drained from the soil.

The CS system (pat. pend.) is childlike in its simplicity, according to the manufacturer. A number of slotted, steel clips are slipped onto the flange of each vertical soldier beam, previously driven into the ground. Random lengths of 3-in. x 10-in. sheeting, spanning two or more bays, are then placed against the face of the soldier beams and made fast with an 18-in. long, high-strength steel bar, held by a ¾-in. dia bolt. The driving of soldier beams is the same with the new as with the conventional system.

Through field use on deep excavations for buildings and subways the manufacturer has found the system to: save labor through the elimination of all hand excavation between soldier beam flanges; save time through faster completion of foundations—simultaneous berm removal by machine while sheeting is installed; and save materials through the use of random lengths of sheeting and fastening assemblies—instantly removed for reuse. **Contact Sheeting, Inc., CE-5, 55 East 43rd St., New York 17, N. Y.**

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AWWA Standard Bell Spigot Watermain Fittings—2" through 36".
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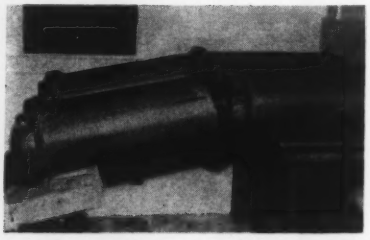
TRINITY VALLEY IRON AND STEEL COMPANY
Phone PE 8-1925
Fort Worth, Texas
P. O. Box 664

Root-Seal Primer

WHEN USED WITH ROOT-SEAL hot pour plastic base sewer joint compound, Root-Seal Primer provides excellent joint sealing properties.

Root-Seal Primer is a quick drying material of such character and consistency that it will produce a hard nontacky coating on the joint surfaces to which it is applied. Not less than 24 hours prior to pipe laying, one continuous and uniform coat of the primer is applied to the clean dry surfaces of the inside of the socket and exterior of the spigot to be jointed.



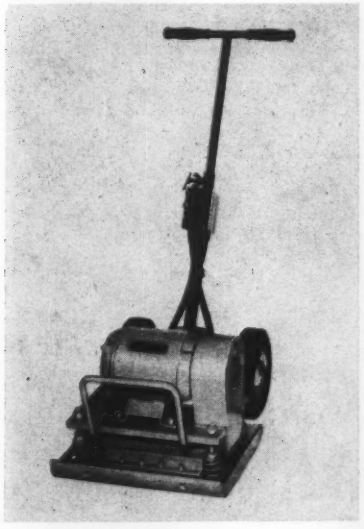
Excellent Joint Sealing Properties

When the pipe has been installed in the trench and lined and graded, dry twisted unoiled jute of sufficient diameter and thickness to center the pipe spigot shall be placed in the pipe annular space and solidly rammed into place in such a manner that it will be tightly against the shoulder at the base of the socket. The depth of joint occupied by joint packing shall not exceed 25 deg of the socket or bell depth. **K. T. Snyder Co., CE-5, 4101 San Jacinto, Houston 4, Texas.**

Self-Propelled Vibratory Compactor

THE SELF-PROPELLED vibratory compactor can now be supplied with a 3-hp, 110/220/440/-V, 60-cycle, 3,450-rpm, single or three phase electric motor in place of the usual gasoline engine and clutch.

The quiet operation of the electric motor drive is desirable when doing soil or blacktop compaction in or around buildings. Another advantage claimed for the Powr-Pactor is its ability to walk in either direction by substituting a reversing switch for the standard dust-tight on-off switch mounted on the handle.



Powr-Pactor

The manufacturer states that the compactor has a fixed vibrating frequency of 6500-vpm and a compacting force of 4,000 lb. It will travel up to 50 ft per min. Damping springs isolate the 12-in. x 18-in. compacting plate from the rest of the machine. Two dolly wheels facilitate moving it into place and out of corners. A water feed attachment and wide rim steel rollers in place of the dolly wheels are available for hot-mix asphalt applications. **Maginniss Power Tool Co., CE-5, 154 Distl Ave., Mansfield, Ohio.**

Compression Couplings

A COMPLETE LINE OF NEW Compression Couplings for joining ½ in. through 2 in. iron pipe, has been announced. The couplings have high grade cast malleable iron sleeves and end nuts, and are standard equipment with wedge-type rubber gaskets. Their overall features are ease of installation and disassembly, a maximum of flexibility, and the incorporation of big coupling principles of design.

The gaskets are of beveled construction so that they draw normally and naturally around the pipe the same as in large steel or cast couplings. This principle of compression insures effectively sealing new pipe as well as pipe which has a large degree of deterioration. It also keeps the gasket free of the sleeve so that the coupling is easily and quickly disassembled. A friction ring prevents gasket scuffing. **Smith-Blair, Inc., CE-5, 535 Railroad Ave., So. San Francisco, Calif.**

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EQUIPMENT, MATERIALS and METHODS

(continued)

Twin Fillet Machine Carriage

THIS NEW TWIN FILLET MACHINE carriage enables automatic welding of stiffeners, flanges, and other structural components from corner to corner, thus eliminating costly manual welding formerly required when utilizing conventional machine carriages.

This heavy duty, aluminum constructed, machine carriage and power supply features dual automatic wire feeds, ensuring maximum production capabilities. The Twin Fillet Mechanized Welder offers the flexibility and ease of handling required for a variety of applications in structural fabrication plants. **L and B Welding Equipment, Inc., CE-5, 2424 6th St., Berkeley, Calif.**

Paving Breaker

KNOWN AS DAVEY-HOLMAN Model SS-32, this medium weight paving breaker is said to have an extremely high power-to-weight ratio and to be suitable for all but the heaviest demolition jobs.

An outstanding feature is the complete housing by the cylinder of the entire valve mechanism; a single hat-shaped, short-travel main valve controls the high speed piston. The handle is fitted with an outside type trigger and the throttle valve has a replaceable leakproof rubber seating. The main valve assembly is held rigidly in the cylinder by a rubber buffer, which is said to eliminate much of the vibration. **Davey Compressor Co., CE-5, Kent, Ohio.**

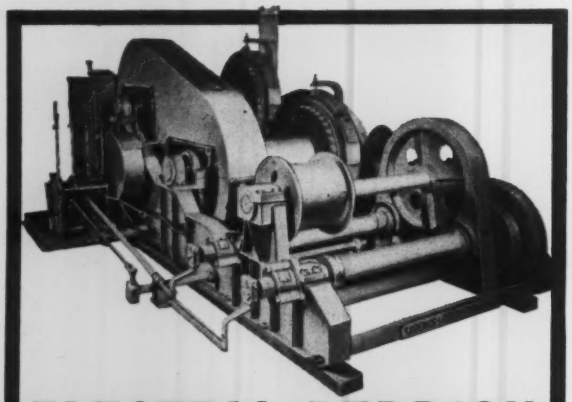
Water-Repellent Masonry Fill Insulation

A FREE-FLOWING GRANULAR material, this new Water-Repellent Masonry Fill Insulation reaches every corner and crevice of the cavity wall. The first low-cost water-repellent insulation readily available for block and cavity walls, the material can reduce heat loss by more than 50%, according to the manufacturer.

This insulation can be used in block and cavity wall construction for homes, schools, dormitories, churches, motels, commercial and industrial buildings, and supermarkets.

Reaches Every Corner

Severe tests of the insulation show that it sheds 75% more water than other types of insulation. Water does not rise in the material through capillarity when exposed to water for extended periods. Even after water is poured through the material, it remains free-flowing and will not cake or ball. Exposure to severe moisture conditions will not destroy its insulating efficiency. **Zonolite Co., CE-5, 135 S. LaSalle St., Chicago 3, Ill.**



ELECTRIC DERRICK HOISTS

S-L-M serves the St. Lawrence Seaway by supplying Electric Derrick Hoists as shown.

Your derrick hoist requirements can also be met with hard working, durable Hoists and Swingers arranged, designed and built to your requirements.

Flexibility of design is a feature of these hoists as each is arranged to suit exact requirements, yet consist of a combination of standard parts.

Write for Bulletins and Catalogs

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Dimensions and Weight Ideally Proportioned for Convenience and Accuracy

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Needle 2½"

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Surveyor's staff compass of highest quality. Ball and socket staff mounting. Beveled and graduated straight edge for plane table work. Outside diam. 5". Furnished in leather carrying case.
MODEL A $40.00
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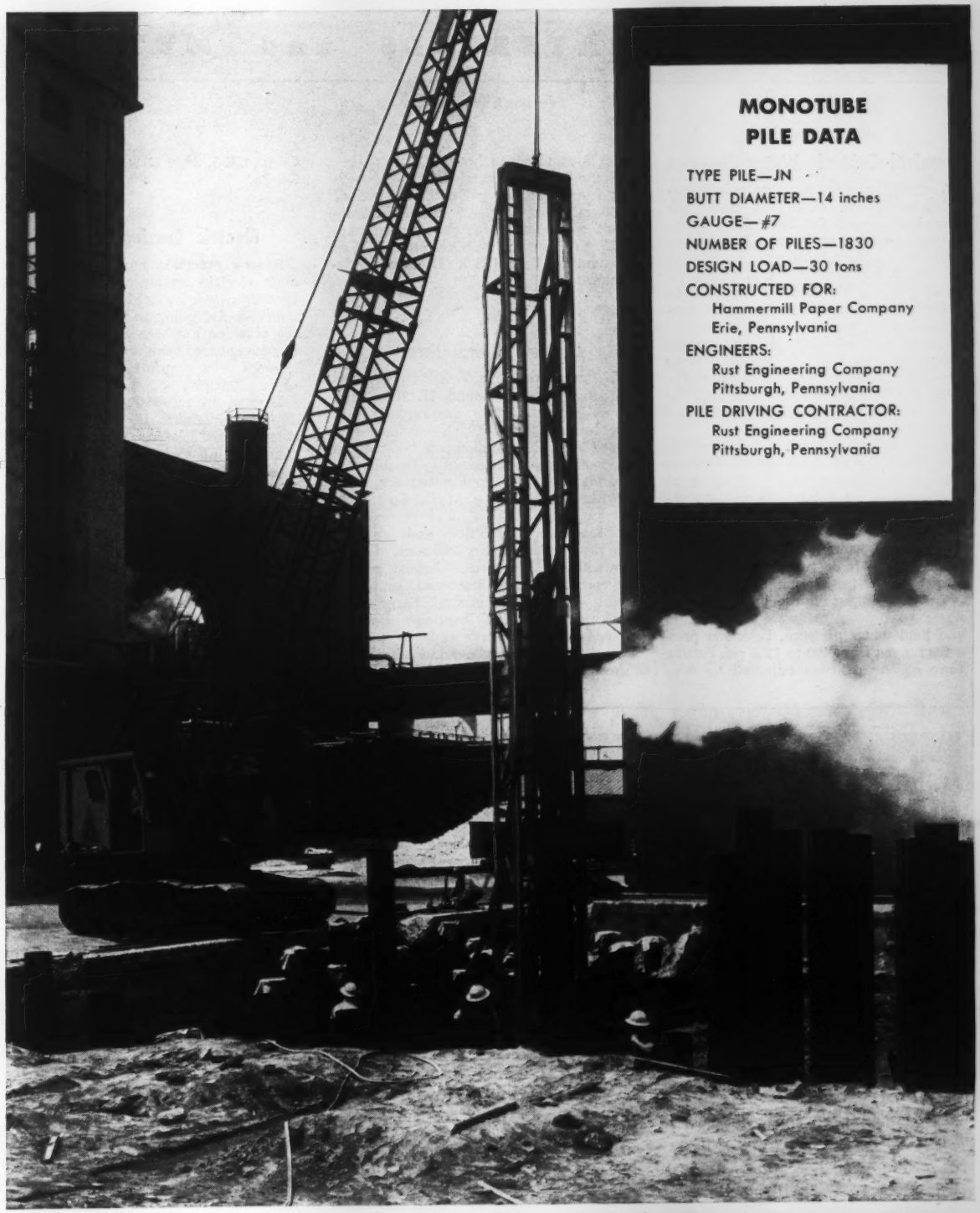


MONOTUBE PILE DATA

TYPE PILE—JN
BUTT DIAMETER—14 inches
GAUGE—#7
NUMBER OF PILES—1830
DESIGN LOAD—30 tons
CONSTRUCTED FOR:
Hammermill Paper Company
Erie, Pennsylvania
ENGINEERS:
Rust Engineering Company
Pittsburgh, Pennsylvania
PILE DRIVING CONTRACTOR:
Rust Engineering Company
Pittsburgh, Pennsylvania

DEPENDABILITY plus ECONOMY with Monotube piles. Fast installation of over 1800 Monotube foundation tubes is the progress report on this plant addition for Hammermill Paper Co., Erie, Pennsylvania.

Tapered, fluted Monotube piles are available in lengths, diameters and gauges to meet every requirement. Write The Union Metal Manufacturing Co., Canton 5, Ohio, for complete information.

UNION METAL

Monotube Foundation Piles

(continued)

Chemical Controls Water Seepage

A CHEMICAL FIRST USED TO reduce water intrusion in air-drilled wells has proved successful for controlling water seepage where conventional grouting materials and methods were unable to halt the troublesome flows. A polymeric water gel, the chemical is expected to prove useful in general tunneling operations.

It was successful in a butane storage cavern at Sun Oil Company's Marcus Hook, Pa. refinery, where cement slurry could not be forced into the relatively tight cracks and crevices in the gneiss-type rock.

The gel and a special resin cement were used for the treatments—the cement was employed as a bulking agent when spaces were large enough to require filling prior to sealing. The two materials were mixed in batches within the cavern, 306 ft below the surface. Holes 6 to 32-ft deep were drilled to intersect the water-bearing fissures, packers were then set in the holes and the water control agents were squeezed in and held under pressure. Injection pressures ranged from 400 to 1200 psi. Setting time of the gel was adjusted to vary from 8 min to one hour.

Some 600 treatments were made, varying from 3 to 800 gal each. A total of 7946 gal of gel and 736 gal of resin cement were consumed, reducing seepage 95% to ½ gpm. **Halliburton Oil Well Cementing Co., CE-5, Duncan, Oklahoma.**

New Gearmotors

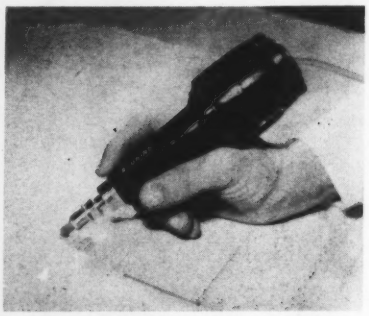
KNOWN AS PHILADELPHIA GEARMOTOR drives, sizes J and H, these new large-size gearmotors are rated up to 200 hp and feature high efficiencies of 94 to 97%, depending upon the number of reductions incorporated. Double, triple and quadruple reductions are available in AGMA ratios ranging up to 440:1.

Maximum durability and strength are designed and built into each of these new drives. Final stage helical gearing is carburized and hardened, and gear teeth are precision ground. Large diameter shafting and over-size bearings have sufficient reserve capacity to handle the most severe overhung loads and shock conditions. **Philadelphia Gear Corp., CE-5, 3620 G Street, Philadelphia 34, Pa.**

Electric Erasing Machine

A NEW PRECISION CONSTRUCTED hollow shaft electric erasing machine, Bruning Electric Eraser Model 3831, has been announced. According to the manufacturer, the machine has been carefully designed to provide engineers and draftsmen with added erasing comfort and greater operating efficiency.

Housed in an attractive lightweight die-cast aluminum housing with baked enamel finish, it has symmetrical contours and no sharp edges. The easy-to-hold unit features a non-slip gripping surface. A tapered, pencil-like shank permits



Non-Slip Gripping Surface

easy manipulation in close quarters and relaxed gripping.

An additional safety feature is a positive-lock chuck to prevent eraser wobble or "flyouts." The 7-in. eraser inserts are firmly gripped at the end by a chuck and chuck ring. Above the chuck, the entire eraser length is contained in the hollow core of the shaft. **Charles Bruning Co., Inc., CE-5, 1800 West Central Road, Mount Prospect, Ill.**

New Fastener

A NEW CONCEPT THAT sharply cuts assembly and erection time in building construction was used for the first time in a structural steel application in an addition to the company's plant in Detroit. The high-tensile Huckbolt fastener, an automatically installed threadless lockbolt, was used to assemble and erect 30-in. x 30-ft long steel girders that form the structural steel.

Huckbolt fasteners, as used in this application, replace hot rivets or high-tensile bolts. Lockbolts of ½ in. dia are used in fabricating the girders as well as in joining them to the upright steel

(Continued on page 138)

KERRIGAN IRON WORKS, INC.—DEPT. CE-5—Nashville, Tenn.

Please send me your new aluminum grating catalog containing engineering data.

NAME _____

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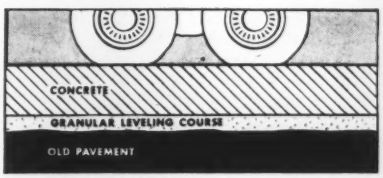
CITY _____ STATE _____

Runways at Chicago's O'Hare Field now converted to jet use by an overlay of CONCRETE



With concrete, the strength is in the concrete itself. It is not just a smoothing overlay. Loads can be computed *mathematically*. With the bearing values of the soil plus the old pavement at O'Hare, 11 inches of concrete did the job—a big savings. Because the flexible pavement had become channelized and rutted, a 3-inch granular leveling course was used to insure uniform concrete thickness.

Resurfacing with concrete turns old runways into new. . . brings them up to jet-age needs

At Chicago-O'Hare International Airport, they simply covered the flexible pavement with modern concrete. With the old pavement serving as a subbase, 11 inches of concrete gives the necessary strength to handle the heaviest jet wheel loads expected.

The *beam* strength of concrete makes such overlays possible. Concrete is the only paving material that can be precisely designed to match *future* loads. That's why concrete runways can be expected to last 50 years and longer. There won't be any waviness or channelization, even under 150-ton jet airliner weights. And concrete withstands the heat of jet blasts, and the action of spilled fuel, as no other pavement can.

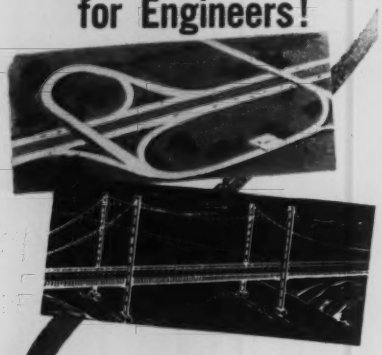
Concrete is the high-safety pavement — pilots themselves will tell you this. It is light-colored for maximum visibility. Its grainy surface means dependable skid resistance and better braking. Concrete creates no dragging action on take-offs.

These material and engineering advantages that make modern concrete ideal for airports make it unexcelled too, for highways of every class. Mile after mile of concrete across the country proves it can do the job better—and do it for less money in the long run!

PORTLAND CEMENT ASSOCIATION

A national organization to improve and extend the uses of concrete

ELECTRONIC
COMPUTING CENTER
for Engineers!



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Here's how it works. You just turn over your computing problems to us. We maintain the equipment to do all or any part of the job. You get the services of qualified mathematicians and technicians. Experience with problems like yours—which assures high quality work that is a 25-year tradition at STATISTICAL. You even have the benefit of our large library of "packaged" programs at no cost.

And you pay *a low hourly machine rate* of only $70 per hour.

Why not let one of our staff of specialists discuss your needs with you? Just phone or write our nearest office.

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EQUIPMENT MATERIALS and METHODS

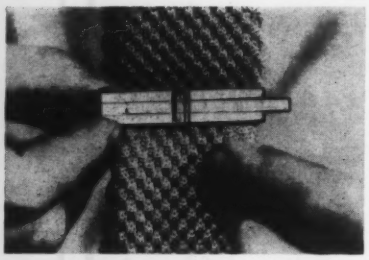
(continued)

columns. Automatically installed, at a rate of speed with power tools, every fastener is uniform and immune from human error.

The fastener is of two-piece design, making it simpler to stock, handle and apply. It is cold-driven, thus avoiding distortion problems inherent in hot-driven fasteners. Since every fastener is automatically and uniformly installed with built-in tensile preload, "torque" inspection following installation is not required. **Huck Manufacturing Co., CE-5, 2480 Bellevue Ave., Detroit 7, Mich.**

Slide Rule Tie Clasp

THE SLIDE RULE TIE CLASP is a miniature slide rule—2 in. long—that actually works. Fully calibrated with scales A, C and D, it has magnifier and etched numbers, and is especially suitable for architects, draftsmen, designers, engineers, and students.



2 In. Long

The tie clasp is available in sterling silver or gold plate, and is packaged in a gift box. The price is $6.95, tax and postage included. **Sherry's, CE-5, 290-V Northwest 36th St., Miami 37, Florida.**

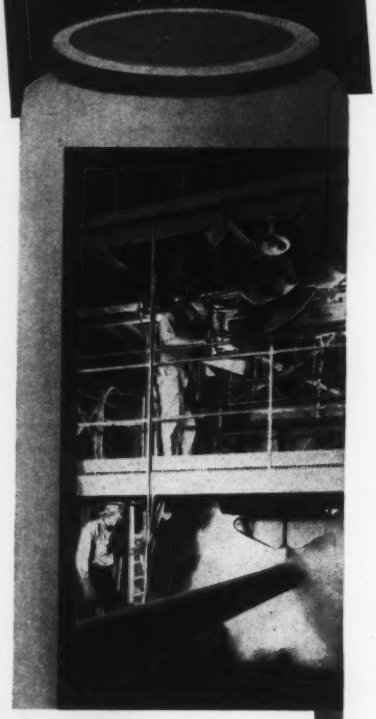
Truck Mixer Batching Plant

ACCORDING TO THE MANUFACTURER, the new TPA-TPC truck mixer batching plant practically eliminates distance hauling. It is a job-site plant, operates either on gas or electricity and can be moved easily to keep up with progress on the job.

Some of the features claimed for the plant are: the set-up time is 3 hours; both units are mounted on rubber tires and are moved with two truck tractors; all conveying and batching equipment is permanently attached; and nothing is removed either for transit or operation.

(Continued on page 140)

WATER PIPE
by SOUTHERN PIPE



STEAM FOR STRENGTH

Southern Pipe's exclusive steam coating process means greater early strength, higher early set. Water pipe that sets stronger, quicker, is less liable to damage. There is no excess moisture; coating is less permeable. Customers get better corrosion protection.

Cement Mortar Lined and Coated Steel Pipe is one of many types of quality water pipe completely fabricated and processed in Southern Pipe's own plant.

Find out more about Water Pipe by Southern Pipe. Write for illustrated brochure.

Southern Pipe

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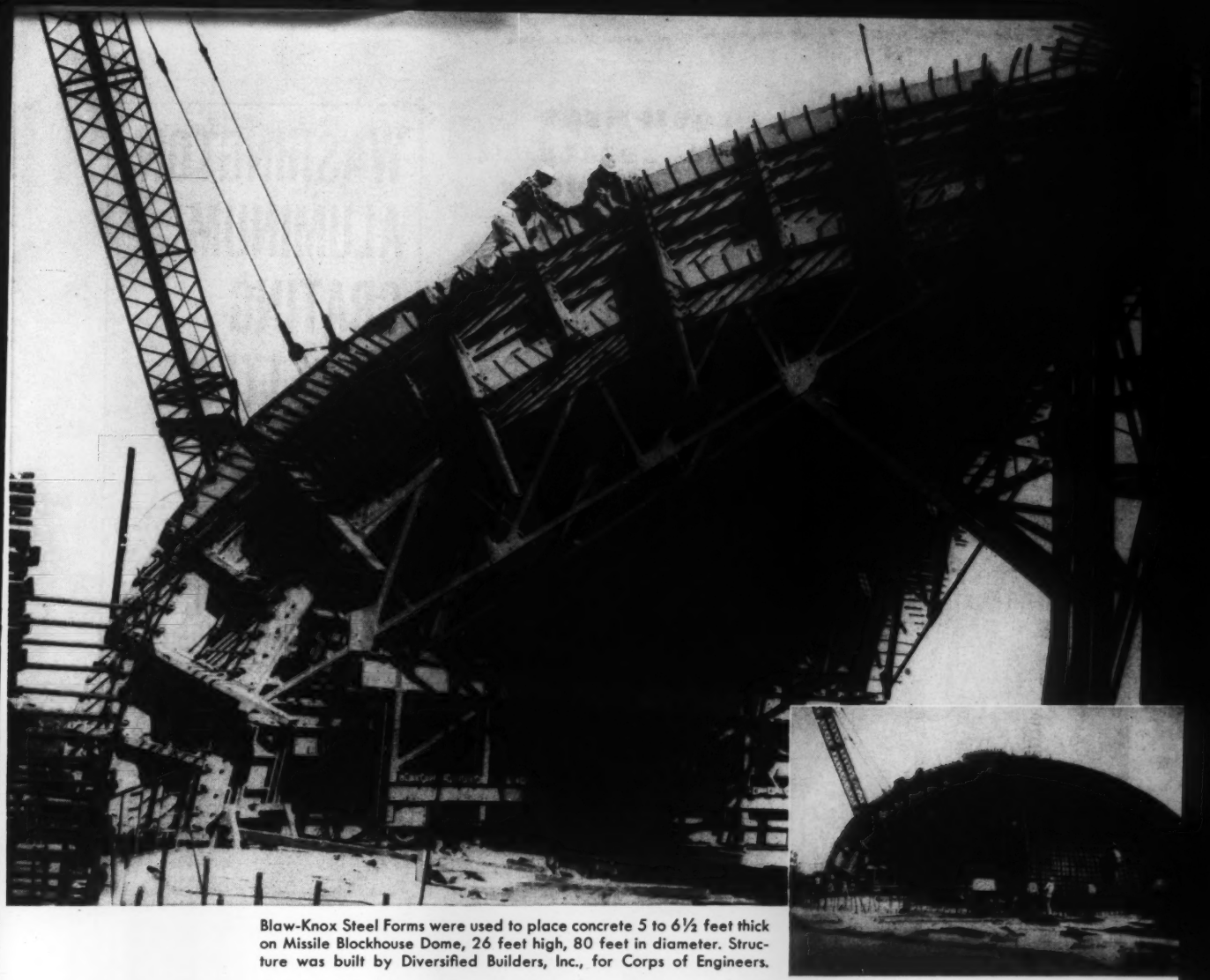

Blaw-Knox Steel Forms were used to place concrete 5 to 6½ feet thick on Missile Blockhouse Dome, 26 feet high, 80 feet in diameter. Structure was built by Diversified Builders, Inc., for Corps of Engineers.

Blaw-Knox Steel Forms used in construction of Cape Canaveral Missile Blockhouse Domes

Traveler-mounted forms sectionalized for removal through 6 x 8-foot personnel exits

1,900 cubic-yards of 3,750 p.s.i. concrete, 5 to 6½ feet thick, was placed in specially designed Blaw-Knox Steel Forms in the construction of each Missile Blockhouse Dome at the Air Force Missile Test Center, Cape Canaveral, Florida.

Concrete was placed first in a 5-foot deep, 12-foot diameter, central compression ring. Inside surface forms mounted on rubber-tire travelers, and fabricated in two 60-degree, "orange peel" shapes, 12 feet wide at the inside base and 1 foot wide at the inside crown, were set. Screw jacks under the 28-foot long travelers raised and lowered the forms. After pouring and curing, the travelers' wheels were set at an angle to allow the forms to traverse circumferentially to the next pour, thus completing the inside pours in three 120-degree sections. All inside surface forms and related framework, travelers, and falsework were disassembled in less than three days and removed through the 6 x 8-foot personnel exit.

Outside surface forms and bulkhead panel sections were positioned by truck-mounted cranes. Concrete was placed at the rate of 60 cubic yards per hour with two Blaw-Knox, 1-cubic-yard concrete buckets. The entire concreting operation was completed in 48 days.

Concreting of Missile Blockhouse Domes, like dams, bridges, and tunnels, can be merchanized to cut costs. Call Blaw-Knox Steel Forms Consultation Service early in your planning for an important engineering contribution to your project.

BLAW-KNOX

BLAW-KNOX COMPANY

Blaw-Knox Equipment Division • Pittsburgh 38, Pennsylvania

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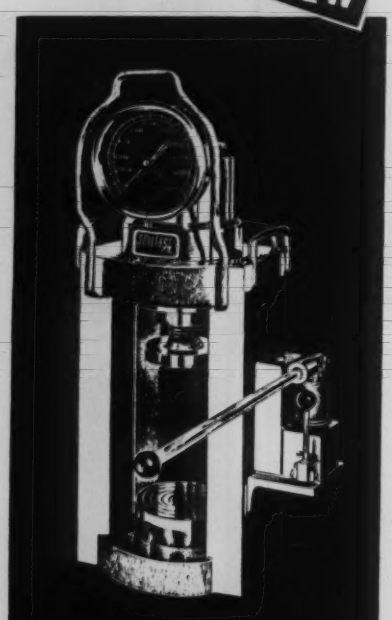
SAVE TIME ON ALL CONSTRUCTION BY TESTING WITH A NEW



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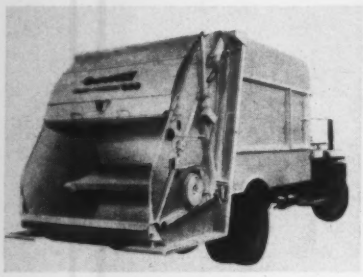
EQUIPMENT MATERIALS and METHODS

(continued)

In the TPC Automatic, both charging and discharging valves are air operated. The charging valve is equipped with an electric eye for preliminary and final cutoff; inching control is included on the discharge valve. When the start button is pushed, the cement is weighed, the fill valve closing automatically at exact weight desired. **Erie Strayer Co., CE-5, 612 Geis Rd., Erie, Pa.**

New Load-Packer

A NEW REFUSE COLLECTION UNIT, the "600," incorporates a number of new mechanical features including a telescopic hoist that does not require a hoist sub-frame, simplified controls, an exceptionally efficient hydraulic system and a large 1½-cu yd hopper. According to the company, the Load-Packer has been designed to incorporate six major requirements: fastest operation, biggest legal payload, largest, lowest hopper, safest, most dependable operation, and greatest economy.



Simplified Controls

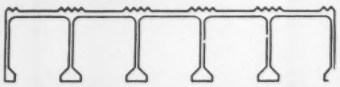
The manufacturer states that the "600" features the fastest packing cycle in the industry; once the hopper is filled, a touch of the controls actuates the rotary loading panel, sweeping the load from the hopper into position. Here the refuse is packed toward the front of the body by direct thrust compaction into a voidless load. The entire cycle takes only 10 sec. The crew can begin reloading after 4 sec. **Gar Wood Industries, Inc., CE-5, Wayne, Michigan.**

Steel Joists

A NEW LINE OF STEEL joists so designed that architects and builders can obtain load-carrying capacities merely by selecting required sizes and depths has been announced.

(Continued on page 142)

WASHINGTON ALUMINUM GRATING IS BETTER BECAUSE...



SPECIAL I-BEAM DESIGN EXTRUSION IS STRONGER

Here's grating that's lighter in weight per square foot, yet has "steel strength". Will actually carry greater loads per foot of span than comparable gratings! Can be fabricated to any length, width, shape; to support any weight load.

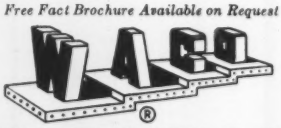
UPSET PATTERN IS SAFER

Even under wet, greasy, other hazardous conditions, the ridged upset design assures all-directional sure footedness. Non-magnetic, non-sparking.

FABRICATED TO LAST LONGER

Panels are made up in multiples of 6" wide extrusions (no individual bearing bars to work loose, splinter or patch). Cutouts are reinforced by continuous weld flat bar band.

Free Fact Brochure Available on Request



WASHINGTON ALUMINUM CO., INC.
Dept. 325, Baltimore 29, Maryland

Streamlined Pipe
FOR THE JET AGE

108 inch Lo-Hed being installed at Offutt Air Base, Nebraska, jet headquarters for the U.S. Strategic Air Command.

LO-HED®
REINFORCED CONCRETE PIPE

Jet airfields require special drainage pipe with features only Lo-Hed can provide. The elliptical shape permits a minimum depth of cover on minimum slopes under vast jet airfields. Also, Lo-Hed will not deflect even under tremendous loads . . . has a smooth, non-inflammable interior . . . assures greater capacity than equivalent size of round pipe.

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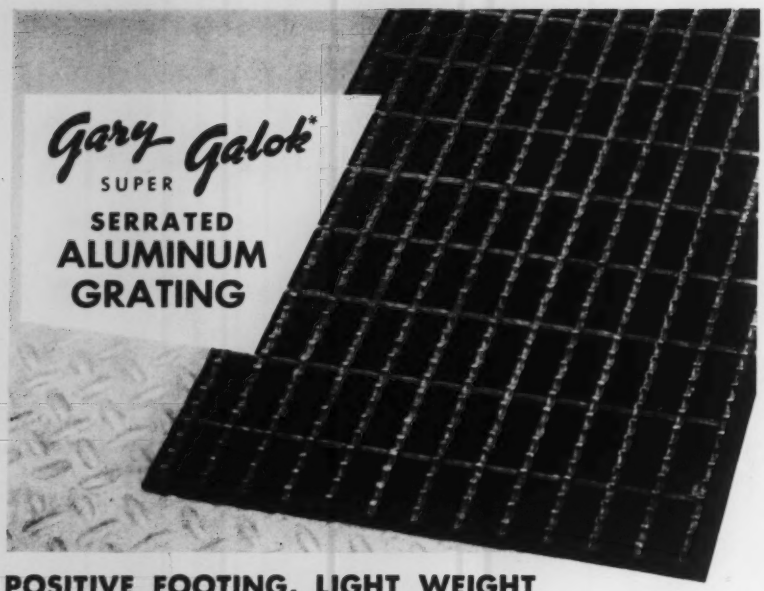

POSITIVE FOOTING, LIGHT WEIGHT

Serrations scientifically designed to provide maximum positive footing and traction. High strength to weight ratio, minimum deflection, maximum safety, corrosion resistant. Bars cannot turn, twist, loosen or fall out. Write for complete details.

*Patents Pending

Gary SUPER Galok aluminum grating also available with plain bars. Both the serrated and plain types in sizes for every need.

ROCKWELL R STANDARD

ROCKWELL-STANDARD
CORPORATION
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4053 E. Seventh Ave., Gary, Indiana

F/S OPTICAL
PLANIMETER
Model 236/A
Eyestrain and parallax in contouring the figure are eliminated by the optical tracer. No need for subtracting the initial reading or adjusting the counting wheel manually.
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EQUIPMENT MATERIALS and METHODS

(continued)

The Truscon joist, available in the Standard or "S" Series, is made of cold formed top and bottom chords. It will support heavier loads over wider unsupported spans. Tensile strength of the joists will be 20,000 lb per sq in. as opposed to the 18,000 lb per sq in. of the previous hot rolled type.

Clear unsupported spans of 48 ft will now be possible with the new joist. Truscon's hot rolled type open web joist will span 40 ft unsupported.

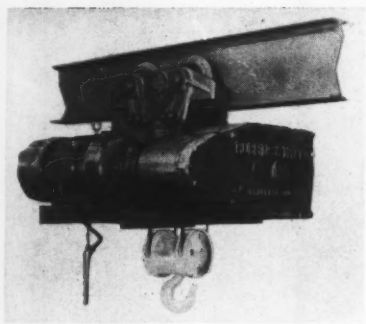
The joist is standardized in dimensions and carrying capacity. By enabling an architect to pick a joist of size and depth right out of the load tables, further design work is eliminated. **Truscon Div. of Republic Steel Corp., CE-5, 1130 Albert St., Youngstown 1, Ohio.**

Low Headroom Hoists

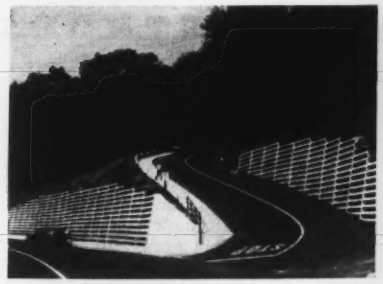
A NEW LINE OF TYPE F3 electric hoists is available in capacities from 1½ through 7½ tons.

The hoists require extremely low headroom. For example, the 5-ton model requires only 24 in. of headroom. Until now such low headroom has frequently required custom designed hoists.

The hoists are powered by a 7½ hp, 30 min, 55 deg C rise, totally enclosed motor with weatherproof brake. This totally-enclosed, magnetic motor brake is the multiple disc type and has extremely short stroke travel to prevent peening. The brake may be adjusted externally without dismantling; only a wrench is required. There are no mechanical linkages. The friction discs are fitted to a splined hub for easy replacement and even distribution of the braking load. Brake coils cannot be overloaded nor the air gap increased excessively; thus the danger of coil burn-out is eliminated. **Robbins & Myers, Inc., CE-5, 1345 Lagonda Ave., Springfield, Ohio.**



No Mechanical Linkages

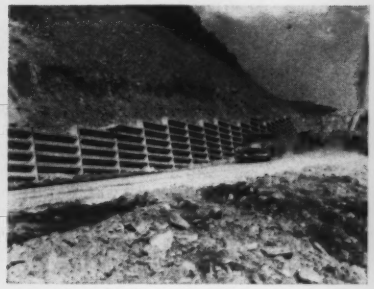


Approach Highways?

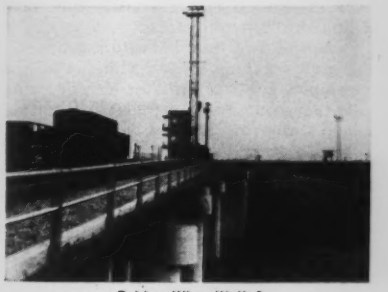
Stabilize Slope?

Stream Erosion?

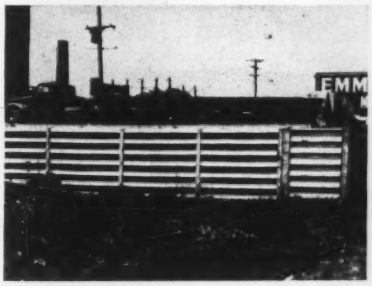
Replacing Existing Wall?



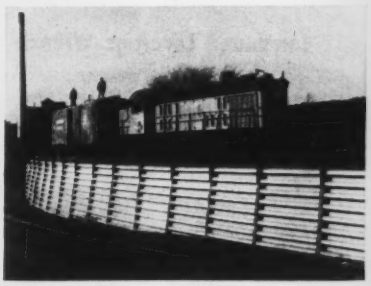
Holding Back Slope?



Bridge Wing Walls?



Gain Parking Area?



Elevated Railroad?

Loading Dock?

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Can Help Solve So Many Engineering Problems

Installation photos answer many application questions on Armco Bin-Type Retaining Walls.

The all-bolted assembly of Armco Walls speeds up installation; there is no waiting for curing. Back-filling and tamping of earth can follow immediately. Because of speed and ease of construction, completed Armco Walls are low in cost. In use for 25 years, they have an enviable durability record.

For complete engineering details, write us for our new Retaining Wall Catalog. Armco Drainage & Metal Products, Inc., 6699 Curtis Street, Middletown, Ohio. In Canada: Guelph, Ontario.

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Portable Pavement Drill

NOT A HASTY MODIFICATION or adaptation of existing equipment, this new portable drill was specifically developed for highway test coring and embodies refinements in design and manufacture dictated by the company's more than 40 years of experience manufacturing core drills and drilling equipment.

Actual field tests indicate a production capacity of up to 65 quality test core samples per 8-hr shift for this rig, which is self-contained, completely portable and trailer mounted to be towed by car, jeep, station wagon or truck. A new adjustable core barrel guide which simplifies the drilling operation, is one of numerous features included as standard equipment. **Acker Drill Co., Inc., CE-5, P.O. Box 830, Scranton 2, Pa.**

New Adhesive

THE DEVELOPMENT OF AN AMAZING new adhesive, Dri-Tac, for wet or dry bonding of wood, metal, plastic, cork, leather, fabric and many other materials, has been announced. With this material only one surface need be coated to form a strong, permanent bond without the use of presses or clamps.

Dri-Tac is a non-inflammable liquid that is easy to apply by brush, spray, roller coating machine, trowel or other conventional cementing methods. For pressure sensitive application only one coat is required, and no primer is necessary. The material makes it possible to bond hardwood flooring directly to concrete or subflooring without use of nails. When applied with a serrated edge trowel, it goes four times as far as asphalt cement, yet gives a much stronger bond and longer tack. Because it dries transparent, and will not stain, Dri-Tac makes it possible to bond thin wood tiles without danger of cement bleeding through. **Adhesive Products Corp.,CE-5, 1660 Boone Ave., New York 60, N. Y.**

Compound Leverage Wrench

THE MANUFACTURER STATES THAT one man can do the work of two and two can do the work of four with the Rigid Compound Leverage Wrench, which can tighten or loosen the stubbornest fitting with ease and complete safety.

These wrenches work with compounded leverage. Pressure applied on the extra-sturdy malleable handle is multiplied by the two adjustable hook jaw turns the pipe in one direction, while the offset chain vise head grips the fitting and exerts an equal pressure in the opposite direction.

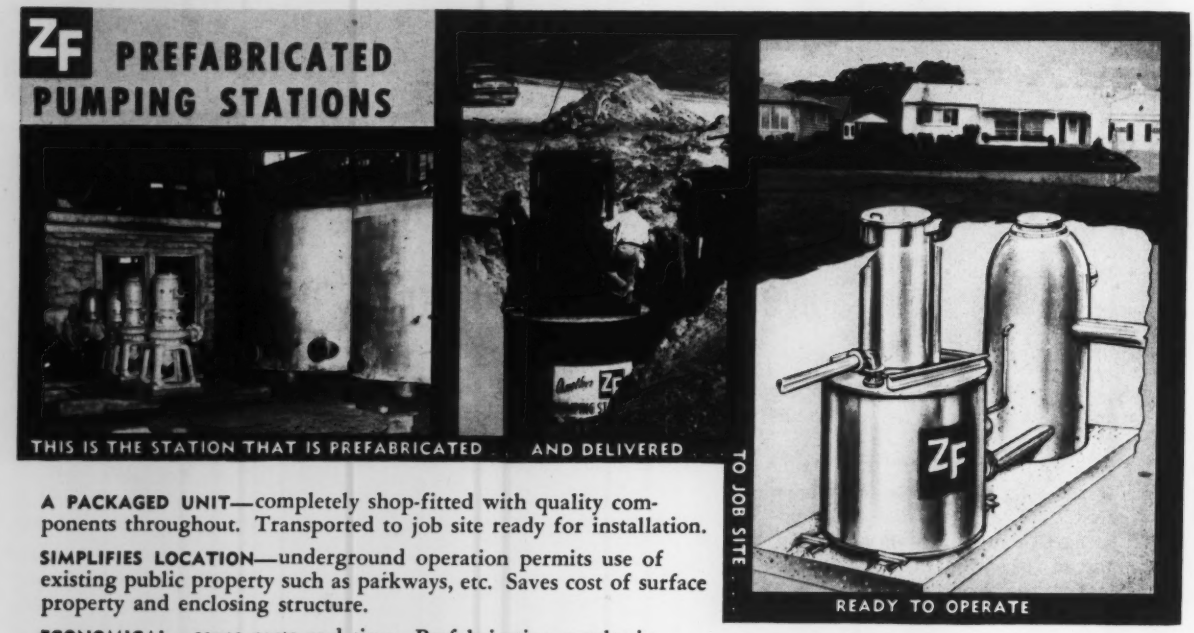
By slipping the removable chain vise head into place on the desired side of the handle, the wrench can be used to tighten or loosen right or left hand threads, with the pipe on either side of the fitting. Short handle for jaw size makes it ideal for close quarters. **The Ridge Tool Co., CE-5, 400 Clark St., Elyria, Ohio.**

New Powered Buggy

THE MODEL 15-B POWERED BUGGY with improved controls, featuring an all new drive engineered specifically for construc-

(Continued on page 145)

ZF PREFABRICATED PUMPING STATIONS



A PACKAGED UNIT—completely shop-fitted with quality components throughout. Transported to job site ready for installation.

SIMPLIFIES LOCATION—underground operation permits use of existing public property such as parkways, etc. Saves cost of surface property and enclosing structure.

ECONOMICAL—saves costs and time. Prefabrication results in lower construction costs and less time at job site. Simply set in place, connect and start up.

COMPLETE DATA, SPECIFICATIONS AND DRAWINGS AVAILABLE—WRITE

ZF ZIMMER & FRANCESCON P.O. BOX 359, MOLINE, ILLINOIS

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THE BRUNTON* POCKET TRANSIT

IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

IT'S VERSATILE...
ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer. Shows direction to 1°; level, slope or grade within 1°.

IT'S MADE TO LAST A LIFETIME
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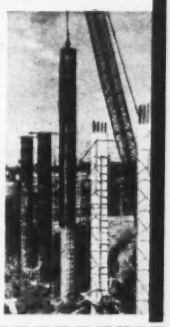
NEW! EFCO
BRIDGE COLUMN
FORMS



EFCO Bridge Column Forms used on New Orleans overpass save time and labor. Precision construction permits quick, easy stripping as shown. Adaptable to a wide range of uses. Ideal for forming pier nosings when combined with regular EFCO Forms.

MAIL COUPON TODAY

Economy Forms Corp.
Box 128-G
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Des Moines, Iowa

Please send information on EFCO Bridge Column Forms, and address of nearest sales office.

Name.....
Firm name.....
Address.....
City.....State.....

EQUIPMENT MATERIALS and METHODS

(continued)

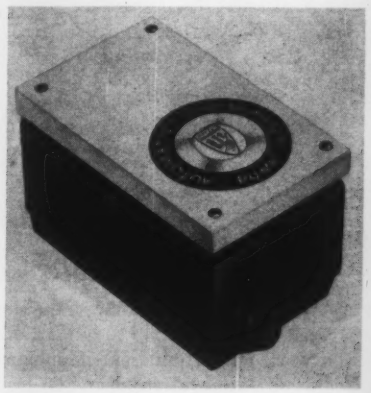
tion use, has been announced. The combination transmission, differential and drive axle assembly is completely enclosed in one housing and is lubricated from one reservoir of oil. The transmission is full torque shifting, constant mesh, with instant shift from forward to reverse.

The Model 15-B has ¾-ton capacity. The 10-cu ft dump bucket latches on the chassis and is quickly interchangeable with a flatbed platform, making it adaptable for hauling concrete, brick, plaster, mortar and other construction materials. **The Prime-Mover Co., CE-5, Muscatine, Iowa.**

Self-Priming Pump

THE MODEL AB-F self-priming, float controlled condensate removal pump, for dehumidifiers and other air conditioning and refrigeration equipment features: patented air-bleed to assure positive self-priming even when drip pan is pumped dry or evaporation causes dry pan; float-controlled for automatic operation; bottom inlet to pump down "low" and remove all the water in a dehumidifier or air conditioner pan; and will handle vertical lifts over 9 ft and horizontal runs up to 300 ft through use of ¼-in. plastic or copper tubing, or hose.

For dehumidifier application, the self-priming pump gives automatic water disposal and eliminates overflow worry and expense; it ends drudgery of manual water removal; the pump improves hu-



Model AB-F

midistat operation by removing water as fast as it collects; and it improves placement of the dehumidifier because it is now located where it belongs regardless of how far the drain is away. **March Manufacturing Co., Inc., CE-5, 8015 North Lawndale Ave., Skokie, Ill.**

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COLOR CATALOG
on
FLOOR ARMORING
describes how
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GRIDSTEEL
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DAMAGE TO YOUR FLOORS
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EQUIPMENT, MATERIALS and METHODS

(continued)

Calculator Computes Asphalt Tonnage

UNIQUE ON THE MARKET is this new circular asphalt calculator, designed to cut down figuring time on asphalt paving requirements. The pocket-size calculator was engineer-developed to simplify calculations of square footage and number of tons of asphaltic paving materials needed for any paving job. It is large enough (5¾ in. dia) to give wide coverage and maximum accuracy.

Originator of the calculator is Mr. E. J. Woodward Jr., Chief Engineer at Industrial Asphalt, Beverly Hills, Calif. Mr. Woodward, who holds AA and BS degrees in chemical engineering, controls operations of 29 asphalt plants and one rock plant for the company. **Hogan & Vecchio, CE-5, 3713-A Arlington Ave., Riverside, Calif.**

New Curtain Wall System

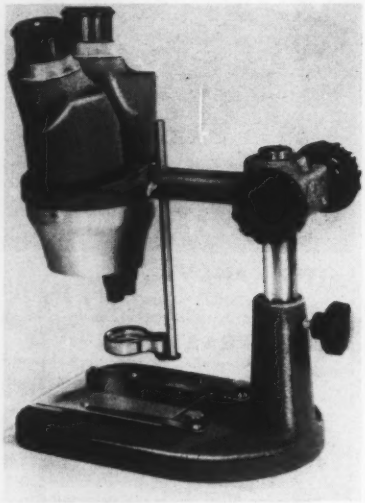
THE FIRST CURTAIN WALL system that requires no supporting framework has been developed. The unusual panel units are completely prefabricated and sealed at the factory with any combination of windows, doors or vents. On the building site they are set into floor and ceiling tracks so quickly that a 300-ft section of wall can be erected in only four days.

The curtain wall system is made of translucent fiberglass plastic panels which are bonded to both sides of an aluminum framework. The resulting panels are so lightweight that two men can easily handle fluids 20 ft high and 4 ft wide.

The panels are also the first all-translucent curtain wall material, according to the manufacturer. Buildings using such translucent panels are flooded with soft glareless light on the darkest days, and at night, when lights are on, they glow with a brilliant beauty that attracts much favorable attention. **Kalwall Corp., CE-5, 43 Union St., Manchester, New Hampshire.**

Industrial Stereo-Microscope

INCREASINGLY IMPORTANT IN quality control, production line inspection, research work and small parts assembly is a new industrial stereo-microscope with low power attachment.



Three-Dimensional Vision

Because it provides three-dimensional vision, the instrument permits the detection of flaws in materials, reveals depth of depressions in surfaces and makes it far easier to interpret images under magnification. Erect image allows production workers to use only normal movements while working on magnified operations. Low power and wider fields of view with depth permit industrial applications impossible with conventional microscopes.

Its features include: 2 sets of objectives on rotating turret for a variety of powers, standard range of interpupilary adjustment, helical rack and pinion focusing—3-in. smooth travel, clear bright image, wide field optics, achromatic objectives and eye lenses, long working distance of 2 and 3 in., and long overhand for examining bulky objects. **Edmund Scientific Co., CE-5, 99 E. Gloucester Pike, Barrington, New Jersey.**

How to handle WET JOBS #47 of a series

Project:
Power Plant, Managua, Nicaragua

Contractor:
The H. K. Ferguson Company, Inc.

Pumping Contractor:
Wellpoint Dewatering Corp.

IN NICARAGUA'S VOLCANIC soil, a Griffin wellpoint system lowers 32 ft of water. Excavated material is used to build a dike (see photo) which protects work area from Lake Managua's waves. No sheeting needed here — excavation open-cut.

GRIFFIN WELLPOINT CORP.

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Jacksonville • West Palm Beach • Houston • Hammond
In Canada: Construction Equipment Co., Ltd. • In Venezuela: Drew Bear & Sons C.A.

Structural Welding Agent

ONE OF THE BIGGEST and oldest problems of the construction industry—joining fresh wet concrete to cured concrete—has been overcome with the development of Uniweld, a new structural welding agent.

Uniweld is an "alloy" of epoxy and nylon type synthetic resins which forms a permanent joint and water and vapor barrier, literally welding the entire contact area without any mechanical interlocking. Tension, compression, shear and

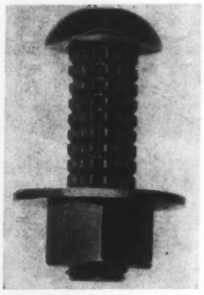
(Continued on page 147)

impact tests show that the bond is many times stronger and tougher than even fully hardened concrete.

The secret behind the remarkable properties of the Uniweld bond is the epoxy-nylon type resin formulation. Epoxies are the only known materials which will form a tenacious bond with cured concrete. Because Uniweld is thermo-setting rather than thermoplastic, the curing process is irreversible and permanent. It does not depend on the evaporation of moisture or solvents and is totally unaffected by water, alkalies, mild acids and many other reagents. **Permagile Corp. of America, CE-5, 3443 56th St., Woodside 77, N.Y.**

High Tensile Structural Rib Bolts

THE NEW HIGH TENSIL Structural Rib Bolt, with rolled interrupted ribs, offers a means of securing a high clamping force and body bound fit in a structural joint. Manufactured to ASTM Spec. A-325 and meeting all of the physical and chemical requirements of that specification, it includes as part of its assembly an A-325 Am. Std. Heavy Semi-finished Hex Nut and one A-325 hardened round washer under the nut. To secure the high clamping force, torque calibration wrenches are used similar to those for other high tensile bolts.

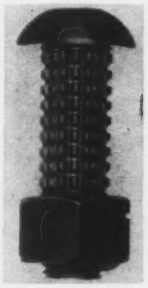


Rolled Interrupted Ribs

The bolt is designed with the proper length of rib for the thickness of the plates, thus preventing the riding of any steel on the bolt threads; the full thickness of the plates are in full bearing at all times.

The "interrupted ribs" fill the hole to create a joint in initial bearing, this body-bound feature eliminating the possibility of slippage in the joints.

• IN ALL APPLICATIONS WHERE HIGH clamping force is not required or cannot be obtained due to difficulty in torquing the nut, the Am. Std. A-325 Semi Finished Hex "Anco" self-locking nut is recommended. It is not necessary to use a round washer under the lock nut.



Self-Locking Nut

The bolt has high shear and bearing values as the ribs cut through the plates creating a body-bound fit and puts the bolt in bearing at all times; there cannot be any slippage, a fact which is very important to the erectors should bolts not be properly torqued.

The slip characteristic of joints having galvanized faying surfaces is similar to that of painted surfaces. The bolt can be used on all galvanized members as there cannot be any slippage into bearing—the bolt is always in bearing. **Automatic Nut Co., CE-5, 16th & Willow Sts., Lebanon, Pa.**

Incinerator Stoker

THROUGH ELECTRONICALLY CONTROLLED operation, the Constant-Flo Incinerator Stoker combines the thoroughly established advantages of "progressive burning", with controlled constant flow of materials through the furnace, plus continuous agitation, breaking up, turning over of the burning mass, and residue disposal.

The alternate moving stoker bars are actuated by powerful and positive hydraulic drives, which are of heavy duty construction, mounted for complete accessibility, and equipped with specially designed control heads for automatic operation.

The automatic operation of these stoker bars is made possible by a thoroughly tested and proven timing device. The entire control system combines flexibility and accuracy, setting the stoker bar operation at maximum efficiency, and continuing the set pattern until further adjustments are desired. Manual operation is available without changing the adjustment of the automatic controls. **Flynn & Emrich Co., CE-5, Holliday & Saratoga Streets, Baltimore 2, Md.**

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★ economy
★ flexibility

• DAMS
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• TUNNELS
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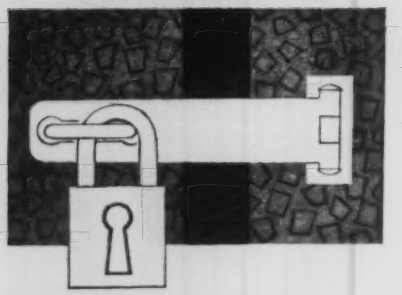
Seal pavements effectively



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FLINTSEAL JFR* ...Jet Fuel Resistant Hot-poured Joint Sealing Compound. It meets Fed. Spec. SS-S-167b. Provides a flexible, durable seal and maintains sure bond through cycles of expansion and contraction of concrete pavement. Keeps water and foreign matter out of joints and cracks.

FLINTAR* . . . Coal Tar Pitch Emulsion sealcoating for asphalt pavements. Meets Fed. Spec. R-P-00355a (GSA-FSS). Applied by brush, squeegee or distributor truck to black-top before serious deterioration begins. Provides needed resistance to oil, grease and water. Improves appearance and prolongs pavement investment many years.

FLINTCRETE† . . . Modified Epoxy-Polysulfide Compounds which produce a bond stronger than original concrete. Used in overlay repairing, dowel grouting, slip-proofing and like work. Material can be applied to damp concrete also. Spreads by brush, squeegee, trowel or spray.

Ask for complete information about entire line.

PAVING PRODUCTS SECTION
THE FLINTKOTE COMPANY
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†Trademark *Reg. U. S. Pat. Off.

FLINTKOTE Manufacturers of diversified products for Home and Industry.

Films Available

"IT'S THE EXTRA JIGGLE THAT COUNTS"—This 16-mm color film describes the history and theory of jigging, one of the oldest forms of mineral beneficiation, as well as the design improvements embodied in the modern Remer Jig. Detailed scenes show modern-day jig treatment of iron ore on the Mesabi Range and at Eagle Mountain, Calif. The jigging of concrete aggregates at several mid-west sand and gravel plants is also shown. **Wemco, CE-5, 650 Fifth St., San Francisco 7, Calif.**

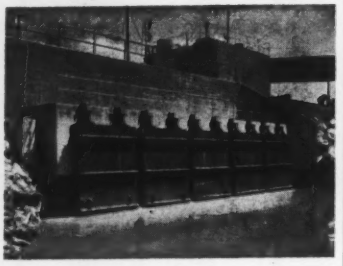
"PURE WATER AND PUBLIC HEALTH"—A new full color, sound motion picture has been produced to encourage people to learn more about the water needs of their communities. The 28-min film is also designed to help municipal and water utility officials secure public support in the planning and construction of new water systems. Featuring Chet Huntley, nationally known commentator, it dramatizes the manner in which a hypothetical town called Riverside solved the problem of an inadequate water supply. **Cast Iron Pipe Research Association, CE-5, Suite 3440 Prudential Plaza, Chicago 1, Ill.**

"AND A GREAT DEAL MORE"—This 19-min color and sound movie depicts the uses of TractoLoaders. The film features on the spot scenes showing the TL-20D TractoLoader and TL-16 TractoLoader in action. Highlighted in the film are TractoLoaders' unique hydraulic systems, which incorporate full flow micronic filter plus screen and magnetic filters. **Tractomotive Corp., CE-5, 589 Edward St., Deerfield, Ill.**

"FROM SEA SANDS TO BETTER WELDING"—A full color film that features the many fascinating steps involved in mining rare and valuable minerals for electrode coatings from the sea sands of Florida has been produced. It pictures millions of tons of mineral bearing sand being moved and processed to secure important basic materials for better welding electrodes. It takes the viewer through the whole operation, showing unique equipment that required years to develop and perfect. The running time is 18 min. **Hobart Bros. Co., CE-5, Hobart Square, Troy, Ohio.**

"WHAT'S IN A NAME"—A new film has been produced to show how a firm celebrating its Centennial in 1959 grew from a one-room shop in Quincy, Ill., into a world-wide company serving the world's basic industries. This 17-min sound and color movie describes the development of Gardner-Denver since its founding in 1859 with a governor for steam engines as its first product. Today the firm makes a line of equipment for construction, petroleum, mining and general industry. **Gardner-Denver Co., CE-5, 100 Williamson St., Quincy, Ill.**

TIDE GATES



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12′ High x 9′ Wide
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on Shockoe Creek,
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Contractor—
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Literature Available

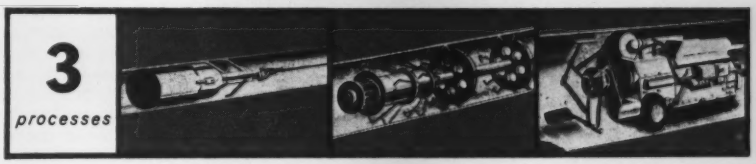
PORTABLE STABILIZER PLANTS—Bulletin S-59 describes two new portable Stabilizer plants designed to provide more accurate proportioning and control of base materials, and to give large capacity operation with minimum costs. These plants provide capacity up to 400 cu yd per hour. Feeder, mixer and aggregate conveyor are wheel mounted, to give extreme portability and to operate in running position without jacking up or cribbing. **Hetherington & Berner, Inc., CE-5, 700 Kentucky Ave., Indianapolis 7, Indiana.**

NEW GRADALL—In a new illustrated folder, the Model G-1000 Gradall is fully described and portrayed. Shown at work on a variety of jobs, it is pictured as both truck-mounted and crawler-mounted. This machine has a lifting capacity of seven tons and it turns throughout 360 deg with a continuous powerful hydraulic swing, driven by two hydraulic motors furnishing a total of 30 hp. It will dig to 18 ft 3 in. and boom extensions increase the digging depth to 27 ft; its loading height is 18½ ft. **The Warner & Swasey Co., CE-5, 5701 Carnegie Ave., Cleveland, Ohio.**

ELECTRIC BLASTING—This new 60-page Handbook of Electric Blasting makes plain, for novice or experienced blaster, the whys and hows of effective electric blast detonation. Technical terms are explained in such a way as to give the beginner in electricity sufficient knowledge to enable him to use electric blasting successfully. Among the subjects covered are: the advantages of electric blasting over old methods, the nature and construction of an electric blasting cap, and the sources of power for electric blasting. Tables and graphs are given for current delivered by standard blasting machines, resistance of copper wire and caps and electric blasting circuits. **Atlas Powder Co., CE-5, New Murphy Rd., Wilmington 99, Delaware.**

ALUMINIZED FENCE—This fully illustrated brochure, DH-16A, describes a new method of aluminizing fence fabric. It provides new beauty with the strength of steel bolstered by the weather resistance of an aluminum coating, which not only resists the penetration of corrosive agents, but also regenerates by forming a new aluminum oxide film over an area from which the original coating may have been removed by abrasion or any other type of rubbing action. Two other brochures available are DH-26, which gives a clear picture of various styles and construction of Chain Link Fence for industrial usage and DH-334 B, which describes residential fencing. **Page Steel & Wire Div., American Chain & Cable Co., Inc., CE-5, 230 Park Ave., New York 17, N. Y.**

REHABILITATE
OLD, CORRODED OR LEAKY PIPE LINES



THE TATE PROCESS is for pipe diameters from 4" to 16" and is done, "in place," after by-pass lines are set up to carry on with water service.

First, the pipe is scraped and cleaned. Then, cement mortar is fed in and applied under pressure to a compact thickness of 3/16" to 1/4" giving the final effect of one continuous, cement mortar lined tube.

THE SPUNLINE PROCESS is partly TATE and partly centrifugal, developed to provide a thin lining for preventing corrosion and to restore hydraulic flow, particularly in cast iron pipe. The cement mortar lining can go through bends and past openings. It can be applied "in place." Uninterrupted continuity is obtained.

CENTRILINE Centrifugal Process. Cement mortar lining ingredients are mixed to rigid requirements and applied under a high velocity spray with uniform speed. Rotating steel trowels spread the mortar to a smooth, hard finish. Pipe sizes vary from 16" on up to 144". Clay, cement, brick, steel, cast iron and wrought iron pipes may be CENTRILINED.

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DIVISION OF AMERICAN PIPE & CONSTRUCTION CO.

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FORT COLLINS HYDRAULICS DIVISION CONFERENCE

July 1-3, 1959

To help the Conference Committee plan for your attendance, please complete the following form. No obligation is implied.

☐ I plan to attend the Hydraulics Division Conference in Fort Collins, Colo., July 1-3, 1959.

☐ My wife and ☐ children (ages.....) will accompany me.

☐ I plan to take the Pre-Conference Tour. Please reserve ☐ tickets for me. I will send a check or money order to cover the cost of the tickets before June 15th.

☐ Please send Chamber of Commerce information.

Please complete the following form for accommodations. List type of accommodation in order of preference:

☐ Dormitory ☐ Hotel ☐ Motel

☐ Poudre Canyon Lodge

Requests for accommodations should include a retainer of $7.00 to secure reservations. Make all checks payable to CSURF, Fund 504, SF 629-12, Colorado State University, Fort Collins, Colo. (CSURF stands for Colorado State University Research Foundation.)

HOUSING ACCOMMODATIONS: Available June 29 through July 3

Campus Dormitory:

$2.00 per person double
$2.50 per person single
All rooms are with two single beds.

Hotels:

Single rooms from $3.75
Double rooms from $5.00
Twin-bed rooms from $6.50

Poudre Canyon Lodges and AAA Motels:

$6-$9 for 2 persons; $8-12 for 4 persons

Poudre Canyon Lodges are approximately one hour's drive from Fort Collins.

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PITTSBURGH: EMPIRE BLDG.
OF CANADA: 2052 ST. CATHERINE ST. WEST, MONTREAL

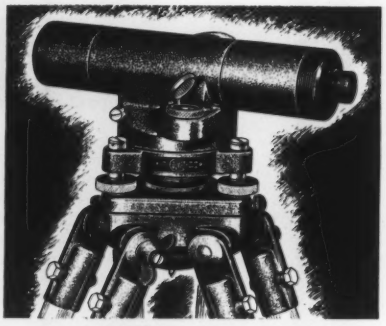
Literature Available

ALUMINUM SAFETY TREADS—A complete new line of aluminum base, abrasive filled safety treads and nosings are shown in a 20-page architectural catalog for 1959. Constructed of heat-treated extruded aluminum, Alloy No. 6063-T5, filled with aluminum oxide abrasive grit, the treads are ¼-in. thick with 3/16-in. deep abrasive penetration—65% more grit than any other safety tread previously made. New "Time-Saver" anchors are a special feature for fresh concrete installation; the treads arrive on the job with anchors attached saving time over fastening numerous anchors in the field. **Wooster Products, Inc., CE-5, Spruce St., Wooster, Ohio.**

THICKENERS—Bulletin SM-1004 describes beam, truss and center-column supported thickener mechanisms; traction thickeners; balanced, washing and combination tray thickeners; reactor-thickeners; hydroseparators; and with cutaway diagrams and installation photos, the 8-page brochure also describes optional features such as manual, motorized or automatic lifting devices which raise the entire mechanism, and unique Thixo arms for use in thixothropic slimes and other slurries. **Process Engineers, Inc., Div. of The Eimco Corp., CE-5, 420 Peninsular Ave., San Mateo, Calif.**

HYDRAULIC VIBRATION SNUBBER—Engineers responsible for pipe stress analysis in the design of piping and high temperature process systems for petroleum refineries, power plants, chemical plants, paper mills, and steel mills will be interested in a new product described in Catalog 229A. This device, a hydraulic vibration snubber designated by the trademark name "Vibrasnub", functions as a stop or restraint for dynamic vibration and shock loads. The advantages of the snubber include low cost, simplicity, and long life, together with little, if any, maintenance. **Barco Manufacturing Co., CE-5, 500-530 N. Hough St., Barrington, Ill.**

CONTINUOUS-MIX BITUMINOUS PLANTS—This 8-page catalog describes the "Commercial" Bituminous Mixing Units which combine the advantages of low investment, economical operation with efficient continuous production. With the ability to produce up to 45 tons per hour and more, of many types of asphaltic concrete, the "Commercial" plants can adequately handle such jobs as parking lots, driveways, schoolyards, city streets and alleys or any other type of commercial work without the expense of starting up and operating a larger plant. **Iowa Manufacturing Co., CE-5, 916 16th St., N.E., Cedar Rapids, Iowa.**



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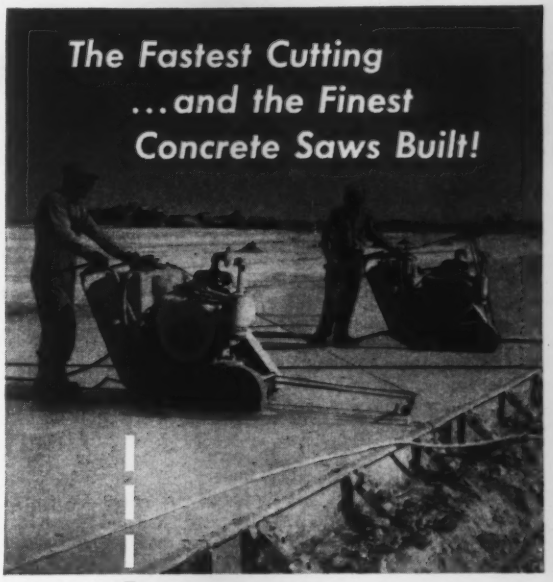
From the MANUFACTURERS

CONTRACTS RECEIVED: Transall Inc., Birmingham, Ala., has recently received what is believed to be the largest single contract for conveyor equipment ever to be awarded to a local concern in the South. This contract amounts to over one-million dollars. The conveyors are for Southern Electric Generating Co., a million kilowatt steam plant now under construction at Wilsonville, Ala., which is owned jointly by the Alabama Power Co. and the Georgia Power Co. . . . Clark Bros. Co. of Olean, N. Y., a division of Dresser Industries, Dallas, Texas, has received a contract from the United States Army for a research project in the field of atomic power . . . **FRANCHISE REPRESENTATIVE NAMED:** Crest Concrete Systems, Inc., Chicago, has been named franchise representative in that area for the Prescon System of post-tensioning concrete . . . **NEW SALES OFFICES:** The Pittsburgh-Des Moines Steel Co. has announced the opening of new district sales offices at New York City and Baltimore. The New York Office takes over the duties previously handled by the Newark, New Jersey Office, now discontinued . . . **NAME CHANGES:** Brunner & Lay-Eastern, Inc. is the new name for Brunner & Lay Rock Bit of Philadelphia, Inc. The Philadelphia address and phone number remain the same . . . Hooper Concrete Pipe Co., subsidiary of American Pipe & Construction Co., will now be called the American Concrete Pipe Co. . . . **NEW ACQUISITION:** Infilco Inc. announces the acquisition of the Gale Separator Co. of Bloomfield, N. J. The activities of the Gale Co. will be continued and merged with Infilco operations in the field of coolant and cutting oil cleaning and recovery . . . **DISTRIBUTORS APPOINTED:** Street-Robbins-Morrow, Ltd., Calgary, Wetaskiwin and Lethbridge, Alta., has been appointed a distributor in Alberta for Bucyrus-Erie Co. of Canada, Ltd., Guelph, Ont. . . . Brown Pipe & Supply Co., Albuquerque, N. M., is now distributing new 4-D wrought iron pipe for A. M. Byers Co., Pittsburgh, one of the world's largest producers of 4-D wrought iron products . . . **NEW FACILITIES REPORTED:** Alvin & Co., Inc., Windsor, Conn., has recently opened their new 10,000 sq ft building, which is in addition to the bulk warehouse which they presently occupy. It will provide up-to-date packing and shipping facilities for one of the most progressive importers, distributors and manufacturers of drawing and drafting instruments and materials . . . **NEW DIVISIONS:** The addition of a new division of Yuba consolidated Industries, Inc., has been announced. Called Yuba Consolidated Erectors, Inc., the division will perform on a national basis all field erection work for the company's heavy steel fabrication divisions . . . The Austin Co., Cleveland, Ohio, has announced the establishment of a new Mining & Metals Div. for specialized service to mining, concentrating and primary metal producing and processing industries . . . **PACKAGE LEASE PLAN:** A special Package Lease Plan for the construction industry was announced by Nationwide Leasing Co., Chicago, Ill., under which any combination of equipment may be considered one package and leased as a unit for three to five years. This plan permits large and small firms to acquire $10,000, $25,000, $50,000 or more in equipment without capital investment. **SALES INCREASE:** A sharp increase in sales for 1958 over the previous year was reported by Symons Clamp & Mfg. Co., Chicago, Ill., makers of prefab forms and concrete accessories . . . **STEEL STOCKS EXPANDED:** Steel stocks of the Steel Warehouse Division of The R.C. Mahon Co., Detroit, have now been expanded to include both resistance welded, hot-rolled square and rectangular steel tubing, and special submerged arc welded, hot-rolled square and rectangular steel tubing . . . **APPOINTMENTS:** Smith & Loveless, Inc., Kansas City, Mo., has announced the appointment of Art Parchen as advertising manager . . . Donald F. Hastings has been named District Manager in Moline, Ill., for The Lincoln Electric Co. . . . The Board of Directors of Universal Manufacturing Corp., Zelienople, Pa., reports the election of Robert L. Carbeau as president.



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PROCEEDINGS AVAILABLE

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1984. The Hydrology of Urban Runoff, by A. L. Tholin and Clint J. Keifer. (SA) A study of rainfall-runoff relationships in urban areas based upon a design storm on different types of uniform land use is presented. Design graphs and the effects of variations in areal distribution of rainfall are given.

1985. Discussion of Proceedings Paper 1337, 1592, 1777, 1780, 1782, 1850. (SA) W. W. Towne and W. H. Davis closure to 1337. Eugene A. Hardin closure to 1592. Howard M. Turner on 1777, M. B. McPherson, Harold E. Babbitt on 1780. Herbert Moore on 1782. Russell H. Babcock on 1850.

1986. Discussion of Proceedings Paper 1359, 1497, 1499, 1501, 1507, 1589, 1754. (IR) David B. Willets and Charles A. McCullough closure to 1359. Harvey O. Banks closure to 1497. Earl Harbeck, Jr., closure to 1499. Samuel B. Morris closure to 1501. Wayne D. Criddle closure to 1507. R. S. Willson closure to 1589. Douglas R. Woodward, Alfred R. Golze, Donald McCord Baker on 1754.

1987. Discussion of Proceedings Paper 1569, 1571, 1644, 1770, 1772, 1789. (WW) Russell A. Dilley closure to 1569. Basil W. Wilson corrections to discussion of 1571. P. Bruun and F. Gerritsen closure to 1644. Woodland Gray Shockley, Raymond A. Wheeler, F. K. Morris, Jos. Millecam, James Kip Finch, J. W. Leslie, P. A. Blanquet, R. L. Bostian, Jr., Tsung Lien Chow, W. E. Potter, Arthur B. Cleaves on 1770. Shu Tien Li on 1772. Robert E. Hickson on 1709.

1988. Discussion of Proceedings Paper 1320, 1560, 1630, 1695, 1707, 1708, 1709, 1710, 1711, 1712, 1722, 1865. (ST) Eric L. Erickson and Neil Van Eenam closure to 1320. Kurt H. Gerstle closure to 1560. Frederick H. McDonald no closure notice to 1630. Emilio Rosenblueth, M. J. Murphy and R. I. Skinner and K. M. Adams, R. W. Binder on 1695. C. Scruton on 1707. Herbert S. Safir, W. R. Schriever, Donald C. Bunting, R. C. Gentry, A. G. Davenport, Henri Perrin, C. Scruton on 1708. C. Scruton, Henri Perrin on 1709. C. Scruton, Henri Perrin on 1710. C. Scruton, Henri Perrin on 1711. C. Scruton on 1712. Alexander Dodge corrections to discussion of 1722. Tung Au on 1865.

1989. Discussion of Proceedings Paper 1453, 1530, 1588, 1808, 1809, 1833. (HY). Carl E. Kindsvater and Rolland W. Carter closure to 1453. Emmett M. Laursen closure to 1530. M. B. McPherson and J. V. Radziul closure to 1588. Ven Te Chow, J. L. H. Paulhus on 1808. Ven Te Chow on 1809. Turgut Sarpkaya on 1833.

April

Journals: Engineering Mechanics, Highway, Soil Mechanics and Foundations, Structural, Power, Hydraulics.

1990. Columns Under Combined Bending and Thrust, by Theodore V. Galambos and Robert L. Ketter. (EM) In this paper interaction curves relating critical combination of axial thrust, end-bending moment and slenderness-ratio are developed for pin-ended wide-flange beam-columns which are bent about their major axis.

1991. Seepage Losses From Irrigation Canals, by H. Y. Hammad. (EM) This paper deals with the two-dimensional problem of steady seepage flow under gravity from a canal into a semi-pervious clay layer of finite thickness underlain by a freely permeable layer of sand and gravel in which the peizometric head is very near the canal water level.

1992. Torque-Loaded Continuous Beams of Profile Section, by D. H. Young and J. F. Brahtz. (EM) A formula is given which simplifies the analysis of torsional behavior of a continuous beam subjected to eccentrically applied transverse loads. Its application is illustrated and an experimental study is described.

1993. Operational Aspects of Controlled Access Facilities, by J. E. Havenner. (HW) Operational aspects of extensive mileage of controlled access highways demanding new concepts and techniques in the field of highway administration are presented.

1994. Channel-Slope Factor in Flood-Frequency Analysis, by Manual A. Benson (HY) Annual flood peaks in New England have been related to hydrologic factors, main channel-slope and drainage-area size. The slope for part of the main channel between 85 and 10 percent of the total distance above the gaging point provides the best correlation with flood magnitudes.

1995. Storm Water in the Chicago Area, by Horace P. Ramey. (HY) This paper presents a study of past and recent flood conditions in the Chicago area and some recommendations for their improvement.

1996. Hydraulic Analysis of Surge Tanks by Digital Computer, by Nicholas Barbarossa. (HY) Bases of analyses, machine computation, are presented to demonstrate how surge problems have been solved in 1-1½ hours by an IBM 650 computer.

1997. Two Methods to Compute Water Surface Profiles, by Joe M. Lara and Kenneth B. Schroeder. (HY) Two methods are presented for the computation of water surface profiles used in the devel-

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opment of tail water rating curves and backwater profiles. Examples of each are included.

1998. Physico-Chemical Properties of Soils: Clay Minerals, by R. E. Grim. (SM) Modern concepts of the structure, composition and origin of clay minerals and current procedures for their identification are reviewed.

1999. Physico-Chemical Properties of Soils: Ion Exchange Phenomena, by A. W. Taylor. (SM) The origin of various types of electrical charges carried by soil colloids are described and the influence of different species of exchangeable cations on the forces arising from the electrical fields due to these charges is examined in terms of the theory of the diffuse double layer.

2000. Physico-Chemical Properties of Soils: Soil-Water Systems, by I. Th. Rosenquist. (SM) A part of the water in a clay-water system should be considered as belonging to the mineral phase. Typical clay properties are analyzed in terms of this concept.

2001. Physico-Chemical Properties of Soils: Role of Soil Technology, by T. William Lambe. (SM) This paper first defines and describes the applied science called "soil technology." The contributions that soil technology makes to soil engineering are presented. Some of the future developments in soil knowledge which can be expected are then reviewed.

2002. Theory and Research in Concrete Shell Design, by A. M. Haas. (ST) The design of shells by the classical theory is briefly reviewed to serve as a basis for presenting simplifications in design calculations.

2003. Matric Analysis of Statically Indeterminate Trusses, by Chu-kia Wang. (ST) The use of matric notations for the analysis of statically indeterminate trusses is presented.

2004. Short Flexible Suspension Bridges for Heavy Trucks, by Sven Olof Asplund. (ST) Temporary flexible suspension bridges needed during construction of Swedish hydroelectric power plants to carry heavy trucks are described.

2005. The Plastic Method of Designing Steel Structures, by John Fleetwood Baker. (ST) In England the abortive attempt of the Steel Structures Research Committee in 1936 to produce an acceptable rational elastic method of design led to the consideration of the behavior of structures in the plastic range. The development of the plastic method of design is described.

2006. Engineering Aspects of Santa Susana Nuclear Power Station, by Dallas I. Downs, George E. Deegan and Robert F. Boggus. (PO) A description of a sodium-cooled reactor with associated power plant near Los Angeles, including construction details; reactor design; radiation shielding fuel and waste handling; water treatment; and coolant problems is given.

2007. Discussion of Proceedings Paper 1627, 1799. (HW) G. M. Webb closure to 1627. Bengt F. Friberg on 1799.

2008. Discussion of Proceedings Paper 1292, 1581, 1604, 1897, 1898. (EM) I. K. Silverman closure to 1292, P. P. Biljlaard on 1581. A. Hrennikoff closure to 1604. Wen Liang Chen on 1897. Turgut Sarpkaya on 1898.

2009. Discussion of Proceedings Paper 1633, 1815, 1838, 1909, 1914. (ST) Committee closure to 1633. Dronnadula V. Reddy on 1815. Emilio Rosenblueth on 1838. Kwang-Han Chu on 1909. D. Y. Fok and Tung Au corrections to 1914.

2010. Discussion of Proceedings Paper 1998, 1999, 2000. (SM) Paul F. Kerr on 1998. Philip F. Low on 1999. Alan S. Michaels on 2000.

2011. Discussion of Proceedings Paper 1289, 1535, 1546, 1547, 1548, 1552, 1645, 1648, 1649, 1728, 1729, 1824, 1826. (SM) C. R. Kolb and W. G. Shockley closure to 1289. Roy D. Gaul closure to 1535. Glebe A. Kravetz closure to 1546. Alexander Kline and Milos Polivka closure to 1547. Judson P. Elston closure to 1548. George K. Leonard and Leland F. Grant closure to 1552. H. B. Seed, R. L. McNeill and J. DeGuenin closure to 1645. A. B. Cleaves closure to 1648. A. B. Reeves closure to 1649. R. W. Spencer, P. J. West, J. H. Birman, B. R. Laverty on 1728. Clark W. Fenske on 1729. G. S. Sarkaria and N. L. Worth on 1824. John A. Focht, Jr., Bernt Jakobson, R. G. Ahlvin, Paul A. Parisi on 1826.

2012. Discussion of Proceedings Paper 1450, 1807, 1808, 1809, 1811. (HY) M. R. Carstens closure to 1450. Fred W. Blaisdell and Harold W. Humphreys on 1807. Max A. Kohler on 1808. Erhard E. Dittbrenner, V. M. Yevdjevich on 1809. B. W. Gould on 1811.

2013. Discussion of Proceedings Paper 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748. (PO) F. L. Lawton on 1733. F. L. Lawton, Huai-yun Hsu, Reijo Ito on 1734. F. L. Lawton on 1735. F. L. Lawton on 1736. Carlos Tercero, Geoffrey Davey, Masatoshi Kawase, Tatsuo Mizukoshi, F. L. Lawton on 1737. F. L. Lawton on 1738. F. L. Lawton on 1739. S. Sakurai on 1741. F. L. Lawton, Waldo G. Bowman on 1742. Torald Mundal on 1743. F. L. Lawton on 1744. J. B. Cooke, F. L. Lawton on 1745. G. I. Davey on 1746. J. B. Cooke on 1747. F. L. Lawton on 1748.

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With MASTERPLATE—Lincoln's high-volume production flow of welding machines and electrodes is not interrupted by costly downtime for floor repairs or replacement.

MASTERPLATE . . . and the on-the-job services of the Master Builders field service team . . . is your key to floors that last *4 to 8 times longer than the best plain concrete floor.* They pay for themselves again and again.

On any current or future floor projects, the local Master Builders field man will welcome discussing your requirements. Call him in. He's at your service. Write us for complete information.

The Master Builders Company, Cleveland 3, Ohio
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The Master Builders Company, Ltd., Toronto 9, Ontario
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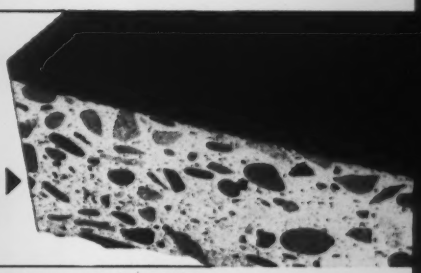
MASTERPLATE provides a thick . . . tough . . . malleable "iron-clad" floor surface.

CONCRETE BASE SLAB FOR MASTERPLATE surface can be monolithic or two-course.



FOR FINISHING NEW CONCRETE FLOORS or re-surfacing old concrete floors — MASTERPLATE withstands impact . . . is oil resistant and virtually non-absorbent . . . easy to clean . . . resistant to many industrial corrosives and strong cleansers . . . *and outwears the best plain concrete floor 4 to 8 times according to tests by top independent testing authorities.*

2-MINUTE TIME EXPOSURE—using "tracer lights"—shows typical continuous, heavy floor traffic pattern over MASTERPLATE floor at Lincoln Electric Co., Cleveland, Ohio—world's largest manufacturer of arc welding equipment.

MASTER BUILDERS® MASTERPLATE*

*MASTERPLATE *is a registered trademark of The Master Builders Co. for its specially prepared, metallic aggregate for producing "iron-clad" concrete floors.*

Horse and buggy transportation in the jet age...

When rapidly increasing population and industrial demands are making water consumption *soar like a jet*, are your water officials forced to go along, horse and buggy fashion, with facilities designed to accommodate a previous generation?

If so, your most immediate needs are new and bigger pipe lines to supplement the old and to replace the obsolete. LOCK JOINT CONCRETE PRESSURE PIPE is the ideal material to implement this important program. Its durability and dependability assure trouble-free service for generations to come. Its initial high carrying capacity is a permanent feature, permitting accurate, long-range estimates of available supply in the distant future.

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